

THINKING

OUTSIDE OF THE CAN



Sustainable Management of Post-consumer Paint and Packaging in Finland

Creative Sustainability
Aalto University
School of Art, Design and Architecture

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Master of Arts thesis abstract

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Abstract

Waste affects all of us, as we all generate it. On average, according to the European Commission (2010), each of the 500 million EU residents produces half a tonne of household rubbish a year. As the amount of waste is increasing, its composition is containing more hazardous materials than before. Current treatments of hazardous waste, such as landfilling and incineration, lead to the loss of valuable materials and a greater resource scarcity. Decorative paint waste contributes to significant volumes of household hazardous waste in Finland, presenting a challenge to the government, society and the natural environment.

The main objective of this study was to analyze current status of leftover decorative paint and packaging waste management in Finland and explore opportunities for making it more sustainable. Also, this study looked at how sustainability in paint relates to user experience. The goal of the user research was to find solutions, which could meet the need of a growing number of environmentally-conscious consumers, who have expectations of companies to improve their sustainability performance.

Questions of paint waste are addressed in this research through the lens of sustainability. In the beginning, this master's thesis evaluates the situation with a management of post-consumer paint and its packaging in Finland and tries to find out how sustainable the paint management is at the moment. Literature

research, official waste management data, interviews and surveys reveal that the existing system lacks an adequate level of sustainability and requires attention. The author suggests that active collaboration and partnership between paint industry actors can help to achieve a gradual change. The Natural Step (TNS) methodology is used to guide this research inquiry, while practical case studies are outlining opportunities and challenges for business application.

Based on the research findings, an SWPM (Sustainable Waste Paint Management) program is suggested to be implemented in the context of Finland. Furthermore, actions for program implementation, stakeholder engagement, challenges and opportunities are described. In the end future research opportunities related to management of post-consumer paint are presented.

Keywords *waste paint, leftover paint, post-consumer paint, paint packaging, sustainable waste management, sustainable user experience, reusing of paint, paint recycling, remanufacturing of paint.*

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List of Abbreviations

| | |
|--------|--|
| A&D | Architectural and Decorative |
| HHW | Household Hazardous Waste |
| FSSD | Framework for Strategic Sustainable Development |
| SPWM | Sustainable Paint Waste Management (program name) |
| EoL | End of Life |
| EU | European Union |
| EPR | Extended Producer Responsibility |
| REACH | The Registration, Evaluation, Authorization & Restriction of Chemicals |
| LEED | Leadership in Energy and Environmental Design |
| BREEAM | The Building Research Establishment Environmental Assessment Method |
| WLP | Waste Latex Paint |
| SWOT | Strengths, Weaknesses, Opportunities and Threats |
| SLCA | Sustainability Life Cycle Assessment |
| LCA | Life Cycle Assessment |
| UX | User experience |
| TNS | The Natural Step |
| PCB | Polychlorinated Biphenyls |
| MSW | Municipal Solid Waste |
| IPPIC | International Paint and Painting Ink Council |
| DIY | Do-It-Yourself |
| OECD | Organization for Economic Cooperation and Development |
| JLY | Jätelaitosyhdistys, Finnish Solid Waste Association |

| | |
|-------------|---|
| HSY | Helsingin Seudun Ympäristöpalvelut, Helsinki Region Environmental Services Authority |
| CIWM | Chartered Institution of Wastes Management |
| AMDEA | The UK trade association for large and small domestic appliances |
| ECHA | European Chemicals Agency |
| USGBC | US Green Building Council |
| VOC | Volatile Organic Compounds |
| EPA | Environmental Protection Agency |
| LMC | Latex Modified Concrete |
| BCF | British Coatings Federation |
| SME | Small to Medium Enterprise |
| UK | United Kingdom |
| US | United States (of America) |
| PALPA | Suomen palautuspakkaus, Finnish packaging return system |
| PYR | Pakkausalan Ympäristörekisteri Oy, The Environmental Register of Packaging |
| AL-cans | Aluminum cans |
| MPMA | Packaging Manufacturers Association |
| Global PSCI | Global Product Stewardship Council |
| Oyj | Osakeyhtiö, Limited company |
| CSR | Corporate Social Responsibility |
| UNEP | United Nations Environment Programme |

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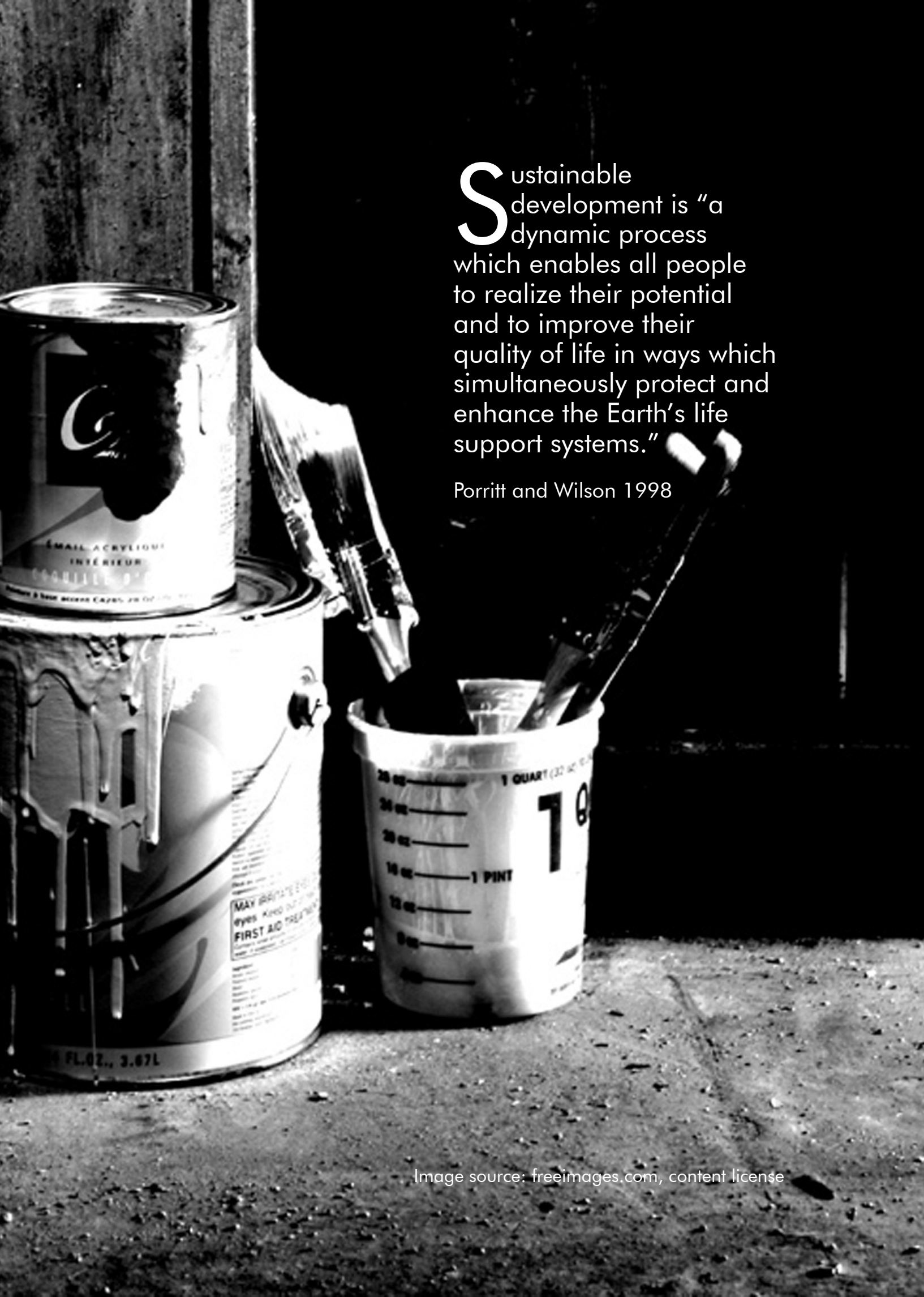
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Sustainable development is “a dynamic process which enables all people to realize their potential and to improve their quality of life in ways which simultaneously protect and enhance the Earth’s life support systems.”

Porritt and Wilson 1998

INTRODUCTION

1.1 Sustainability

The concept of sustainability has become part of our everyday life. The word has gained its popularity not only among environmentalists, social activists, but also business people. Sustainability initiatives have become part of business strategies, innovations and long-term thinking. However, despite it being around us for a long time, the term has been interpreted and practiced in various ways.

The most commonly cited definition of a sustainable development was given in the Bruntland Commission Report to the United Nations in 1987: "Development that meets the needs of the present generation without compromising the ability of future generations to meet their needs" (United Nations 1987). According to Leadbitter (2002), this definition ignores system limitations within which our society operates. In comparison, Porritt and Wilson (1998) from an organization called Forum for the Future define sustainable development as "a dynamic process which enables all people to realize their potential and to improve their quality of life in ways which simultaneously protect and enhance the Earth's life support systems."

The problems of diminishing natural resources and growing population have been putting pressure on the society to bring its development to a sustainable level. Increasing consumption has been overwhelming the planet with growing amounts of waste, hazardous materials and carbon dioxide. The situation must be changed not only by re-thinking management of the most commonly recyclable waste, such as metal, cardboard and glass, but also other materials. These materials, such as paint, are typically considered 'too dangerous' to be put back into the circulation.

Questions of paint waste are addressed in this research through the lens of sustainability and sustainable development. The methodology of The Natural Step (TNS) methodology is used to guide this research inquiry, while practical case studies are outlining opportunities and challenges for business application. TNS was founded by a Swedish scientist, Karl-Henrik Robert, in 1989. The

organization has been helping other commercial and non-commercial entities to move toward sustainability by changing system conditions and using a science-based model, the Framework for Strategic Sustainable Development (The Natural Step 2015).

The Framework for Strategic Sustainable Development is based on four principles of a sustainable society. In order to return Earth back to a sustainable system condition, the following human contributions must be eliminated (The Natural Step 2015):

1. Systematic increase of concentrations of substances extracted from the Earth's crust, such as heavy metals and fossil fuels
2. Systematic increase of concentrations of substances produced by society, such as plastics, PCBs, etc.
3. Systematic physical degradation of nature and natural processes, such as groundwater pollution and deforestation
4. Systematic undermining of people's capacity to meet their basic needs, which include unsafe working conditions and inadequate wages

This research uses the four TNS principles as a guide when looking at challenges and searching for opportunities to implement the necessary shift in how paint waste management has been implemented so far.

1.2 Background Information

Paint waste disposal is strictly regulated in the European Union, because it is defined as hazardous waste. Hazardous waste means that it might be posing a threat to health and environment when disposed of and mixed with non-hazardous waste (Gendebien et al. 2002, p. 1).

When paint is deposited to the landfill, it can produce concentrations of harmful chemicals to air, groundwater and soil. Toxic chemicals from soil can get vaporized, creating high concentrations of toxins in the air. Harmful chemicals can leak from soil into the groundwater, ending up into the water supply. Soil can remain contaminated for a very long time, being harmful for those eating vegetables and plants growing in it, or even simply getting a physical contact with it. (PropEx 2015).

When paint waste is incinerated for energy recovery, carbon dioxide emissions and other harmful substances are produced. After incineration, valuable materials, such as titanium dioxide, limestone, clay and others, cannot any more be used (Benoy et al. 2014, p.63). It leads to an ongoing extraction of natural resources and production of chemical substances for manufacturing of

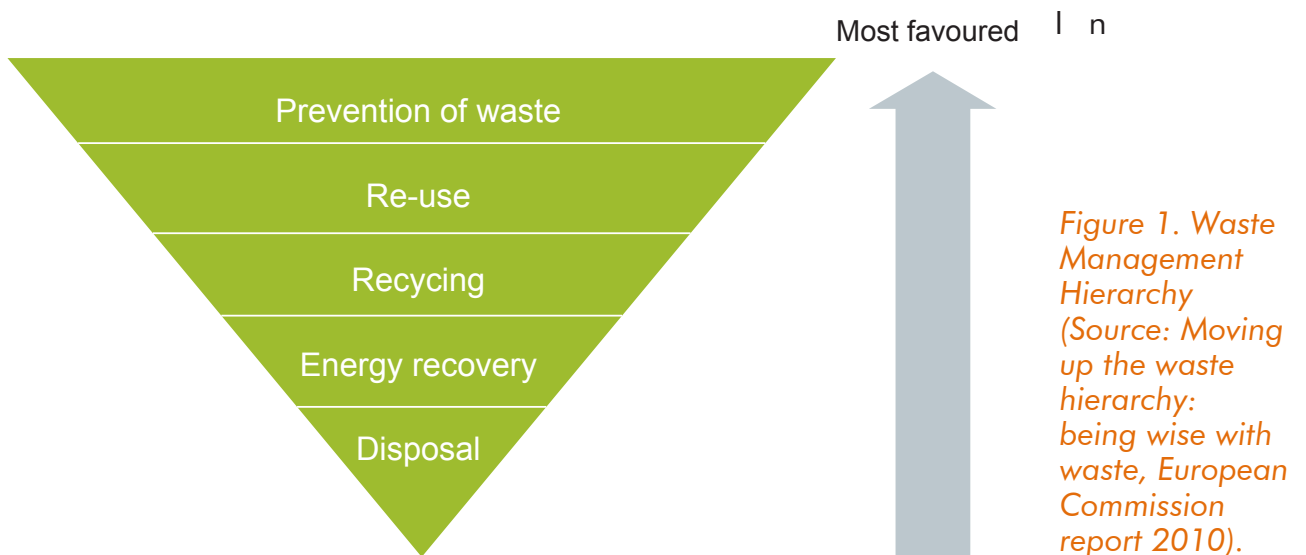
the virgin paint.

In Finland empty metal paint containers can be recycled. Empty plastic containers are deposited into mixed energy waste and later incinerated for energy recovery. Containers with liquid post-consumer paint are dropped off at collection points and later incinerated as well (Tikkurila Oyj 2014). As a result, liquid leftover paint contributes to high incineration rates in Finland and prevents higher plastic recycling rates, making Finland to fall short of the country's environmental commitments.

Already in 2008 the EU Waste Framework Directive has established 50% recycling target for household waste to be fulfilled by 2020. According to the 2013 report by the European Environment Agency (Fischer 2013), Finland has not shown an increase in the recycling rates of MSW in the previous ten years. In 2007, for example, 53% of the municipal waste was sent to landfill (Ecoprog/ Fraunhofer 2010).

1.3 Goals and Objectives

We all have a role in ensuring that our planet's resources are managed in a sustainable way, while considering the needs of future generations. The main objective of this study was to analyze the current status of paint and packaging waste management in Finland and explore opportunities for making it more sustainable.



order to move successfully up the 'waste management hierarchy' (Fig. 1), Europe has been supporting the idea of a circular economy. According to the waste management hierarchy, avoidance, reuse and recycling are the most preferred

methods of post-consumer waste management.

By decreasing the amount of waste sent to landfills and incinerators, Finland has a chance to save valuable resources and reduce its greenhouse gas emissions. By looking at materials from a life-cycle perspective, and promoting reuse and recycling of waste, Finnish municipalities have a chance to decrease hazardous waste management expenses and reach higher national recycling rates.

This research was interested to uncover how sustainability in paint can relate to user experience. The goal of the user research was to find solutions, which could meet the need of a growing number of environmentally-conscious consumers.

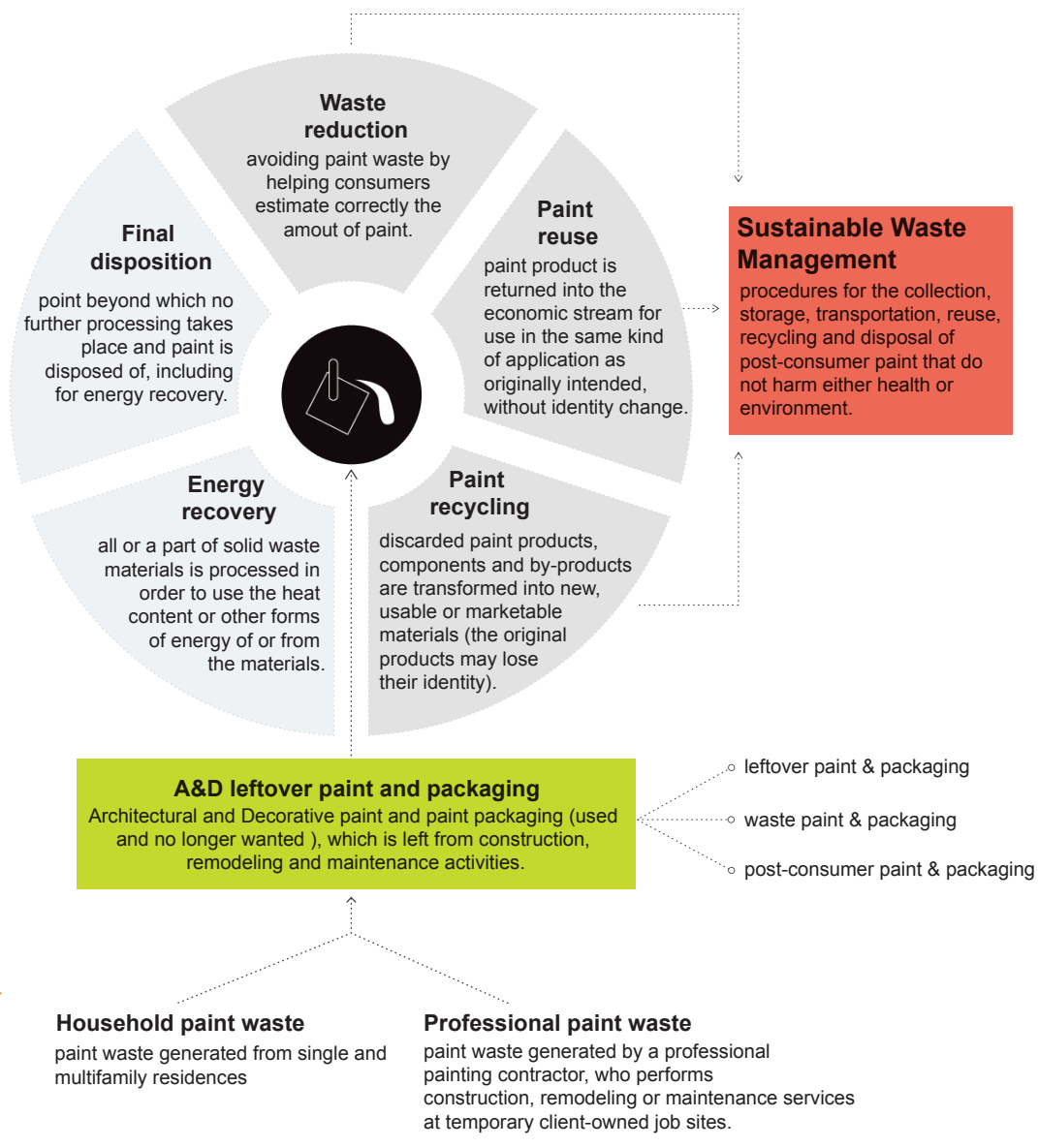


Figure 2.
Research
Scope:
Responsible
management
of A&D
leftover
paint and
packaging.

1.4 Scope of the Studies

This research is focused on Architectural and Decorative (A&D) leftover paint and its packaging, which are used by both professional painters (contractors, construction companies, etc.) and Do-it-Yourself (DIY) clients. A&D coatings are “applied on-site to interior and exterior surfaces of residential, commercial institutional or industrial buildings” (IPPIC 2012, Chapter 2, 2.1). They can be water-borne (latex) or solvent-borne (oil-based) coatings, excluding aerosols, industrial and marine coatings.

A diagram below (Fig. 2) explains the scope of this research. Left-over paint and packaging, which can also be called paint waste or post-consumer paint and packaging, is at the center of the research. Post-consumer paint, which has been used and is no longer wanted, can originate from two different sources. It can be left either after household or trade use, and is thus referred to as household paint waste or trade paint waste.

Management of paint waste and packaging can be arranged in different ways. In this research paint waste reduction, its reuse and recycling are considered to be the most sustainable choices, according to the already mentioned waste management hierarchy (Fig. 1). Other waste management options, such as energy recovery and landfilling, are considered to be less preferred options for the reason of a permanent loss of valuable materials. All three of the sustainable paint waste management practices (paint waste reduction, reuse and recycling) are described in more detail in chapter 4.

1.5 Previous Studies and Methodology

This research was initially supported by the findings from the study, conducted in summer 2014 by Natural Interest, the Helsinki-based consultancy, and Tikkurila, the Finnish paint manufacturer. The author of this graduate thesis worked in the Natural Interest as a project trainee from summer 2014 until winter 2015.

In summer 2014 Natural Interest used Sustainability Life Cycle Assessment (SLCA) to understand how sustainable Tikkurila’s paint production actually was and what kind of positive and negative impacts it had on the environment and society. At the end of the first research phase, paint waste management was selected to be the focus for further research.

In order to find the way to close the ‘loop’ of paint life cycle, a thorough research in the area of post-consumer paint had to be made. After that, the second step was to gain support of the industry stakeholders around paint waste collection and its treatment.

For the research project the following activities were initially planned:

- Research of the waste and chemical legislation in the European Union and Finland
- Analysis of other paint waste management programs
- Engagement of local partners
- User research to gain insight into the methods for consumer engagement

The cooperation project lasted four months: from October 2014 to February 2015 (Fig. 3).

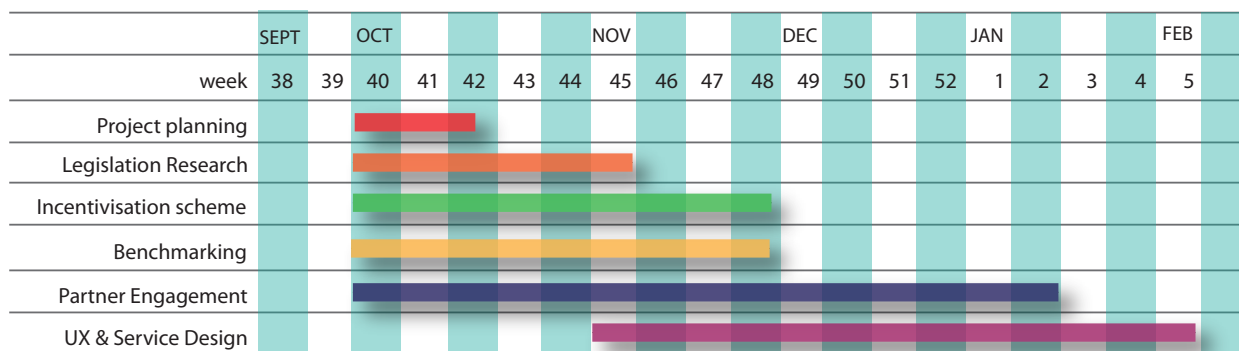


Figure 3. Project schedule (Source: Natural Interest 2014).

In addition to SLCA, this research included both theoretical and practical research methods. From theoretical methods the study used: literature and legislation analysis (books, journal articles, master's and doctoral theses, industry reports, corporate responsibility statements, legislation statutes), and statistical reports on hazardous waste management and packaging. Practical research methods for this master thesis included interviews,* surveys, and user experience research.

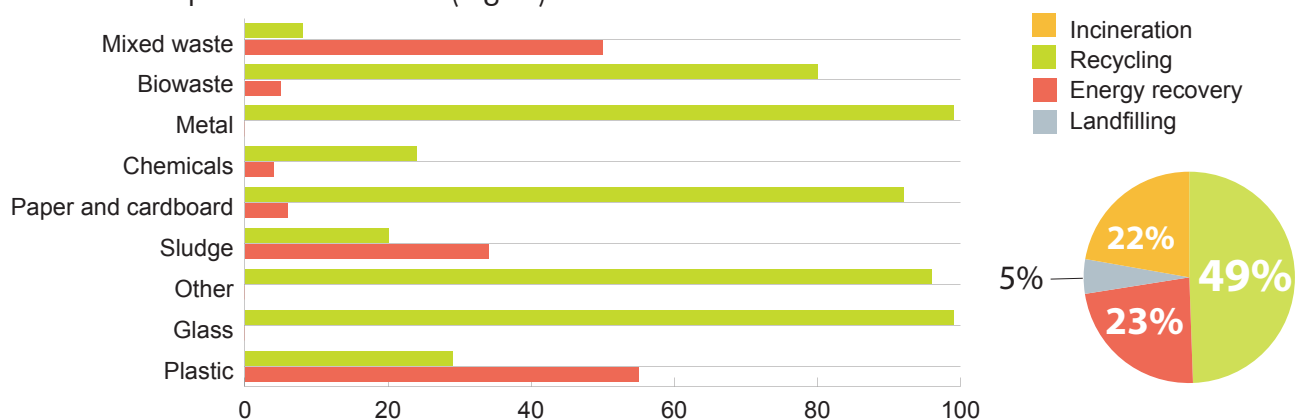
As part of the cooperation with a paint manufacturing company, Tikkurila was a practical study and helped to outline opportunities and challenges for a business application of sustainable paint waste management.

In addition, benchmarking of successful paint reuse and recycling systems, such as Newlife Paints (UK), Community RePaint (UK) and Paint Care (USA), was conducted to identify opportunities and risks involved in paint collection and its treatment. Benchmarking studies were selected based on their unique approach and long-lasting success in sustainable paint waste management. Benchmarking research and case study are described in detail in chapters 6 and 7 accordingly. Other practical research methods, including SLCA, are described in chapter 8.

* The full list of interviewees can be found in Appendix A of this research.

1.6 Implications of Research

At the moment liquid paint waste prevents recycling of plastic paint containers, contributes to significant volumes of hazardous waste and supports growing incineration rates in Finland. Post-consumer plastic packaging has not been previously recycled in Finland, except for PET bottles and polyethylene (Rasmussen 2014, per. com., November 28). According to Statistics Finland (Sitra 2014, p. 13), in 2012, 99 percent of metal and 29 percent of plastics was recycled in Finland. In comparison, out of the total amount of waste, 23 percent were sent for energy recovery. From that amount, 55 percent were plastics and 0 percent was metal (Fig. 4).



Finding new opportunities for recycling and reuse materials supports TNS principles of a sustainable society. Moving up the waste management hierarchy can increase recovery rates of persistent chemicals that would otherwise increase in nature, reduce the use of fossil fuels, and prevent destruction of natural ecosystems.

Priorities of this research also correlate with the country's Producer Responsibility directive and the EU targets. The target is to recycle 50 percent of all municipal waste by 2020, which looks like a challenging task for Finland, based on its long-term stagnated recycling rates of municipal waste.

It can be difficult to reduce sustainability impacts for a single stakeholder, such as a manufacturer or an environmental agency. The reason behind it is that the impacts occur in different parts of a life cycle and are often caused by other than manufacturer parties, such as customers, retailers or suppliers. Sharing the burden of waste management between multiple stakeholders can prove to be a more successful strategy and bring benefits to all participants. For example, manufacturers can strengthen their own brands, support customer loyalty and gain a long-term trust. Sustainable management of waste can change the entire perspective on the subject: it may show that products such as paint contribute to the circular economy instead of being a hazardous product, which is pre-determined to be destroyed.

Figure 4. Material disposal statistics in Finland 2012 (Source: Sitra, Kiertotalouden mahdollisuudet Suomelle 2014).



Image source: freemages.com, content license

WASTE MANAGEMENT

Waste affects all of us, as we all generate it. On average, each of the 500 million EU residents produces half a tonne of household rubbish a year. All together, with manufacturing and construction industries, the European Union produces up to 3 billion tonnes of waste every year. (European Commission 2010).

Waste negatively affects the environment: it causes pollution, degradation of natural resources and greenhouse gas emissions. Landfilled and incinerated waste contributes to material loss, and further dependency on the resource extraction and man-made material production.

Waste levels have been rising as European society has been growing wealthier and the quality of life has been improving. A linear consumption model, adopted after the industrial revolution, has been threatening competitiveness and resilience of European states. In a linear model resources are assumed to be limitless, easy to acquire and dispose of. As a result, loss of valuable and scarce materials has been leading to an even greater resource pressure and insecurity of material supply.

While amounts of waste are increasing, the composition of waste is changing as well (European Commission 2010). In the modern society waste contains more hazardous materials than before. Hazardous content includes heavy metals, toxins, and other substances, which are difficult to handle at the end of a product's useful life.

While separate collection and recycling of bottles, cans and paper have been accomplished for decades, hazardous waste collection, according to Cassel (2008), has often been lacking funding or appropriate system design to protect human health. It has not been an easy task for officials and local communities to organize collection and treatment of an ever-increasing number of hazardous waste, which didn't have a consistent content, but rather included a wide variety of dangerous chemical components.

Regulations for hazardous waste are different in EU Member States, with some states having separate collection plans dedicated for identified hazardous waste types and others having only recommendations encouraging separate collections, but no specific regulations. According to the Final Report of the European Commission study on hazardous household waste, separate collection of hazardous waste is typically organized as a combination of mobile collection, permanent waste collections in municipal amenities and take-back schemes at retail stores (Gendebien et al. 2002, p. 11).

Based on the data from separately collected household hazardous waste in Belgium, Luxembourg and the Netherlands, each resident there is estimated to produce from 1.3 to 3.5 kg of separately collected household hazardous waste per year. Out of the total amount of collected household hazardous waste leftover paint contributes to some of the largest volumes (Gendebien et al. 2002, p. 11).

The growing amount of hazardous waste presents a challenge to municipalities, businesses and society in general. Sustainable growth is not possible without reviewing waste management and its role in society. In a world where competition for scarce resources is increasing, it is necessary to find ways to stop valuable materials from leaking out of the economies. Making better use of resources would bring not only environmental, but also economic benefits.

Changing conventional financial system, infrastructure and consumer disposal behavior requires a transition from the linear model to a circular economy, where resources, including waste, remain within the system and function in an optimal way. Hazardous waste should not be an exception, but rather an area of special attention and opportunities for innovation. Development of markets for secondary materials, services for consumers, collection systems and incentivization can assist with achieving the established goals.

2.1 EU Approach to Waste Management

According to the European Commission, the goal of the EU waste management is to “reduce the environmental and health impacts of waste and improve Europe’s resource efficiency,” eventually making Europe a recycling society (European Commission 2010, p. 2). The European Union has been working towards higher recycling levels and creating a resource-efficient economy by means of environmental action plans and legislation frameworks. Modernized approach to waste management marked a shift in thinking from waste being an unwanted burden to a valued resource instead.

Turning waste into a resource is part of the circular economy concept and the target of ‘closing the loop.’ In 2014 a circular economy package was presented to the European Commission. The aim of it is to help Europe to become a circular

economy with secure access to raw materials, economic growth, increased recycling rates and newly-created jobs (European Commission 2014, p. 1).

Circular Economy

Circular economy is a development strategy representing growth without increasing resource consumption (European Commission, Annex 2014, p. 2). The idea behind a circular economy is to keep value within the economy for as long as possible, so that at the end of a product's life resources can be used over and over again. By relying more on reuse and high-quality recycling, circular economies have a chance to minimize their dependency on raw materials, and to improve their own resilience and competitiveness.

A study for the European Commission estimated that by 2030 resource efficiency can reduce material input needs by as much as 17-24 percent (Meyer 2011). Another study by Greenovate Europe (2012), an Innovation Management Consultancy, has estimated that better use of resources can have an overall savings potential of €630 billion per year for the European industry.

Actions towards a circular economy and resource efficiency would also correspond with the ongoing European initiatives in the areas of carbon emission reduction, increase of energy efficiency, and greenhouse gas emission reduction.

By following the waste management hierarchy, since 1995 Europe has managed to reduce the amount of landfilled municipal waste by more than 25 percent, while energy production from municipal waste generation has more than doubled (European Commission 2010, pp. 7-8, Fig. 5).

Although this shift indicates a step up in the waste hierarchy, energy recovery

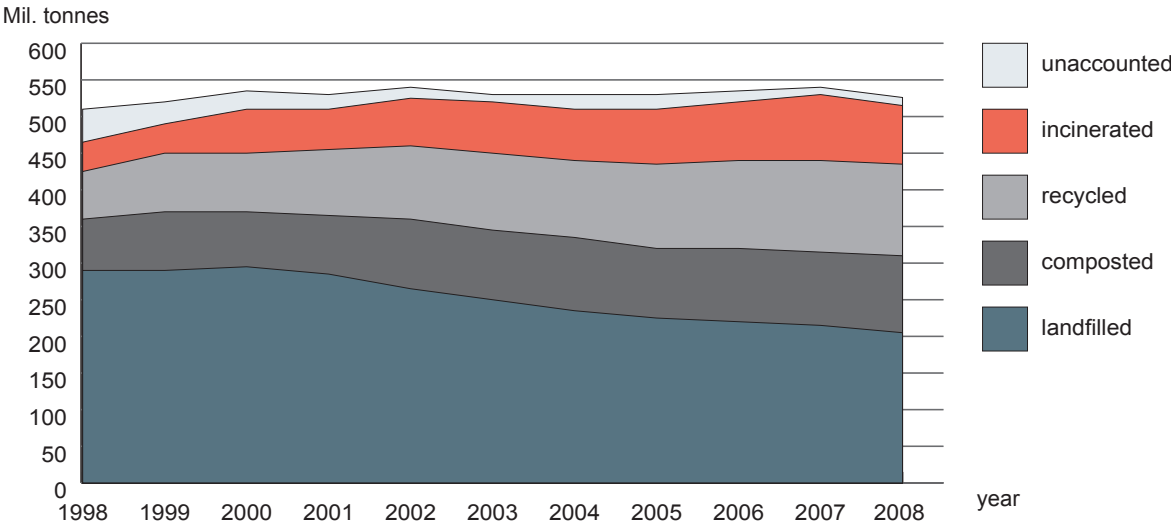


Figure 5. Trends in municipal waste treatment in EU (Source: Eurostat; Being wise with waste, European Commission report, 2010).

should not be an ultimate way of managing waste materials. It results in the loss of valuable materials and systematically increases the need for the extraction of non-renewable resources and production of new man-made materials.

As opposed to energy recovery, recycling not only reduces the amount of waste, but also minimizes the need for material extraction from the natural environment. For example, in case of paint packaging, recycling saves around 95 percent of the energy required to manufacture new cans from virgin materials (European Commission 2010, p.9).

As an alternative to recycling, reuse of the waste materials has social, environmental and economic benefits. A product's useful life can be extended further if it is donated to either community or educational organizations. Material reuse also promotes environmentally responsible consumer behavior, as it motivates at least partial personal participation in handling of the waste materials.

Waste prevention, however, is an ultimate goal, which can be achieved by designing eco-friendly products with the use of recycled secondary materials. Additional services for consumers helping them to calculate precisely the amount of products they need to purchase can reduce unnecessary waste. Offering collection systems for post-consumer waste can also support waste prevention and minimize costs of waste management.

Extended Producer Responsibility

The EU waste policy supports the use of waste as raw materials by setting recycling targets and putting such systems, like Extended Producer Responsibility (EPR), in place to ensure that the targets are met. According to the OECD (2001) definition, The Organization for Economic Cooperation and Development, EPR is "an environmental policy approach in which a producer's responsibility for a product is extended to the post-consumer stage of a product's life cycle." EPR takes responsibility of the waste management from government and shifts it to the industry. In this way, producers are obligated to take responsibility for taking back, sorting and treating for recycling those used goods that they have earlier manufactured.

According to Deloitte (2014, p.10), EPR is a major instrument of the European Waste Hierarchy implementation. It is a behavior change instrument for all the stakeholders involved in the product lifecycle, as well as a motivator in promoting resource efficiency and designing more environmentally-friendly products. If companies have to take care of the post-consumer waste, they might become motivated to rethink durability, recyclability and toxicity of their products. Some other benefits of EPR include its industry-driven character, as opposed to the government-managed programs. By giving responsibilities directly to producers, the programs are pre-determined to be more efficient and effective.

The first time EPR for packaging appeared in some European countries was in the 1980's. Since then it spread over to other parts of Europe, as well as abroad. In Finland EPR has been introduced for graphic papers, old vehicles, tires, electronics, batteries, packaging and medical items. (Deloitte 2014, p.11).

Producers often exercise their responsibility collectively through the schemes, organized by the Producer Responsibility Organizations. For example, the 'Green Dot' program (Fig. 6) is an example of a system, which is engaged in collection and recycling of packaging waste. It has been established in 1990 in Germany and is currently managed by PRO Europe, an organization based in Brussels. In Finland PYR (Pakkausalan Ympäristörekisteri), the Environmental Register of Packaging (Fig. 7), assists companies with fulfilling packaging recovery obligations.



Figure 6. Green Dot label (Source: Gruener Punkt).

Another example of an Extended Producer Responsibility program is the Used Paint EPR Program in New Brunswick province of Canada (Fig. 8). It was founded by the industry in 2008. The program requires brand owners to be registered with it in order to sell paint in the province. It provides a network of over 50 drop-off locations for the used paint and ensures that 70 percent of the collected waste paint is remanufactured into new



Figure 7. PYR (Source: PYR Oy).



Figure 8. Recycle NB website (Source: www.recyclenb.com 2015).

(Recycle NB 2015).

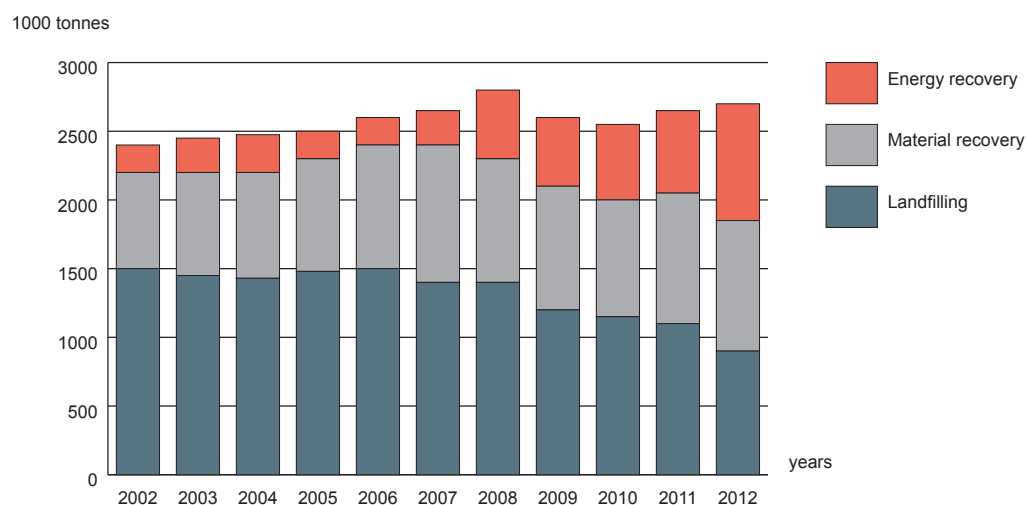
2.2 Waste Management in Finland

The problem of municipal waste treatment can become more acute in the future due to increasing urbanization, growing consumption and improving standards of living. Amounts of municipal waste in Finland have been growing, reaching 2.74 million tonnes in 2012 (Official Statistics of Finland 2012).

In recent years Finland has achieved good results in landfill targets by introducing a landfill tax and a partial landfill ban at the end of 1990s. Later landfill tax has increased almost every 4 years (Fischer 2013, pp. 13-14). However, because there is no tax on incineration of municipal waste, gradually increasing landfill tax rather favors incineration treatment and does not motivate recycling.

According to Fischer (2013, p. 6), landfilled municipal solid waste (MSW) in Finland has reduced from 61 percent in 2001 to 45 percent in 2010. Incinerated MSW increased from 9 percent to 22 percent during the same period of time, and recycling has remained almost completely unchanged at the level of 35 percent (Fig. 9). (Official Statistics of Finland 2014). Breaking historical trend of diverting waste from landfills to incineration has not been an easy task for Finland. Newly introduced policies on recycling, including the Waste Management Act 2011, are focusing on changing a long-lasting pattern and supporting recycling.

*Figure 9.
Municipal
Waste by
treatment
method in
2002-2011
(Source:
Official
Statistics of
Finland 2014).*



According to Timo Hämäläinen, development engineer from JLY (Jätelaitosyhdistys), Finnish Solid Waste Association, the relatively small percentage of recycling in Finland can be explained by low volumes of household waste. He considers the household waste to be a heterogeneous material flow of different materials, from which producing good-quality recycled materials is challenging (Hämäläinen 2014, pers. com., November 19).

Finland has set up its own national waste management plan with a recycling target of 50 percent by 2016. In order to reach this level of recycling, well-coordinated efforts are required from the Finnish government, business community and public sector.

Hazardous Waste Statistics

In 2012 Finland generated hazardous waste in the amount of 1.1 million tonnes, out of which 134,000 tonnes was generated by households (Official Statistics of Finland 2012). While 180,000 tonnes of all generated hazardous waste was incinerated, a more significant amount was deposited in landfills (Official Statistics of Finland 2012). Even with the share of incineration treatment steadily growing in Finland, landfilling still takes place on a large scale, even for hazardous waste.

According to the statistics provided by Leif Bergström (2014, pers. com. November 17), a hazardous waste specialist from HSY (Helsinki Region Environmental Services Authority, Helsingin Seudun Ympäristöpalvelut), in 2013 Kivikko Sortti station alone received 733.3 tonnes of paint waste from private households and 147.2 tonnes from small companies (Fig. 10). It is possible to calculate that from the total amount of collected hazardous waste, paint waste from private households represents 54.8 percent and from small companies - 48.6 percent.

| HOUSEHOLD WASTE | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Total |
|---------------------|------|------|------|-------|------|------|------|-------|-------|-------|------|------|-------|
| lead-acid batteries | 10.2 | 8.6 | 9.5 | 22.4 | 28.5 | 22 | 23.8 | 21.6 | 22 | 17.9 | 13.7 | 10.8 | 211 |
| lubricating oils | 0.8 | 3.8 | 15.9 | 3.6 | 25.2 | 16.6 | 13.7 | 20.7 | 16.4 | 21.7 | 15.6 | 6.3 | 160 |
| paint | 30 | 25.6 | 29.3 | 73.1 | 88.8 | 66.6 | 84.1 | 88.3 | 72.3 | 77.9 | 54.6 | 42.7 | 733 |
| solvents | 0.4 | 0.6 | 0.7 | 2.1 | 3.9 | 1.8 | 2.1 | 1 | 1 | 1 | 0.7 | 0.7 | 16 |
| medicine | 5.6 | 5 | 5.5 | 6.5 | 5.5 | 4.7 | 6.2 | 6.3 | 4.8 | 4.9 | 4.6 | 5.5 | 65.1 |
| fluorescent tubes | 0.8 | 0.7 | 1.7 | 2.7 | 2.8 | 1.5 | 1.6 | 2.5 | 1.6 | 2.7 | 0.8 | 0.7 | 20.1 |
| chemicals | 0.4 | 0.2 | 0.7 | 2 | 2.7 | 1 | 3 | 3.8 | 1 | 2.1 | 0.6 | 0.8 | 18.3 |
| other | 3.2 | 2.4 | 8.5 | 10.5 | 13.3 | 18.4 | 11.2 | 11.9 | 10.8 | 10.3 | 7 | 5.7 | 113 |
| TOTAL (tn) | 51.4 | 46.9 | 71.8 | 122.9 | 171 | 133 | 146 | 156.1 | 129.9 | 138.5 | 97.6 | 73.2 | 1337 |

| BUSINESS WASTE | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Total |
|---------------------|------|------|------|------|------|------|------|------|------|------|------|------|-------|
| lead-acid batteries | 1.7 | 1.5 | 2.5 | 1.6 | 3.3 | 1.8 | 1.4 | 3.2 | 1.8 | 1.3 | 2.2 | 0.7 | 23 |
| lubricating oils | 2.4 | 2.8 | 2.9 | 3.6 | 4.7 | 2.1 | 1.6 | 1.9 | 1.7 | 2.8 | 1.7 | 1.2 | 29.4 |
| paint | 11.4 | 13.1 | 6.2 | 11.2 | 10.9 | 7.1 | 9.4 | 10.6 | 16.7 | 21.5 | 14.7 | 14.4 | 147 |
| solvents | 0.3 | 0.6 | 0.5 | 0.6 | 0.8 | 0.8 | 0.7 | 0.4 | 0.8 | 1.4 | 0.7 | 1.7 | 9.3 |
| fluorescent tubes | 4.2 | 2.7 | 4.7 | 3.9 | 2.5 | 3.7 | 4 | 2.9 | 2.2 | 1.6 | 4.3 | 2.6 | 39.3 |
| chemicals | 1.8 | 0.9 | 0.5 | 0.7 | 0.4 | 2.1 | 1.5 | 0.3 | 2 | 2.1 | 1.5 | 0.7 | 14.5 |
| other | 2.7 | 3 | 2.4 | 2.4 | 1.6 | 9.5 | 1.8 | 3.1 | 2.8 | 5.2 | 2.6 | 2.7 | 39.8 |
| TOTAL (tn) | 24.5 | 24.6 | 19.7 | 24 | 24.2 | 27.1 | 20.4 | 22.4 | 28 | 35.9 | 27.7 | 24 | 303 |

Figure 10. Hazardous waste deposits in 2013, Kivikko Sortti station (Source: HSY, Bergström 2014, pers. com., 17 November).

During the spring months, collection statistics of the waste paint includes paint from both fixed collection points (service stations and Sortti-stations) and hazardous waste collection events.

When looking at the table, it is possible to see that in 2013 waste paint delivered by households increased between April and October months, while deliveries from businesses increased in the period between September and February. It is possible that these differences are a result of higher business activity in the fall-winter period in Finland and a higher number of household renovations, which occur during the summer vacation time. However, it must be mentioned that because statistics from other years are not available, such conclusions are not reliable.

Services for Consumers

The website www.kierratys.info, hosted by JLY, Finnish Solid Waste Association, is an online service platform for finding the closest waste collection point (Fig. 11). It lists different categories of waste, including paint and recyclable packaging waste. The database covers over 27 000 collection points. It is possible to use the service on the computer, phone or tablet.

Disposal of hazardous waste is supported by the collection events, organized once a year by the local waste management companies. JLY provides a nation-

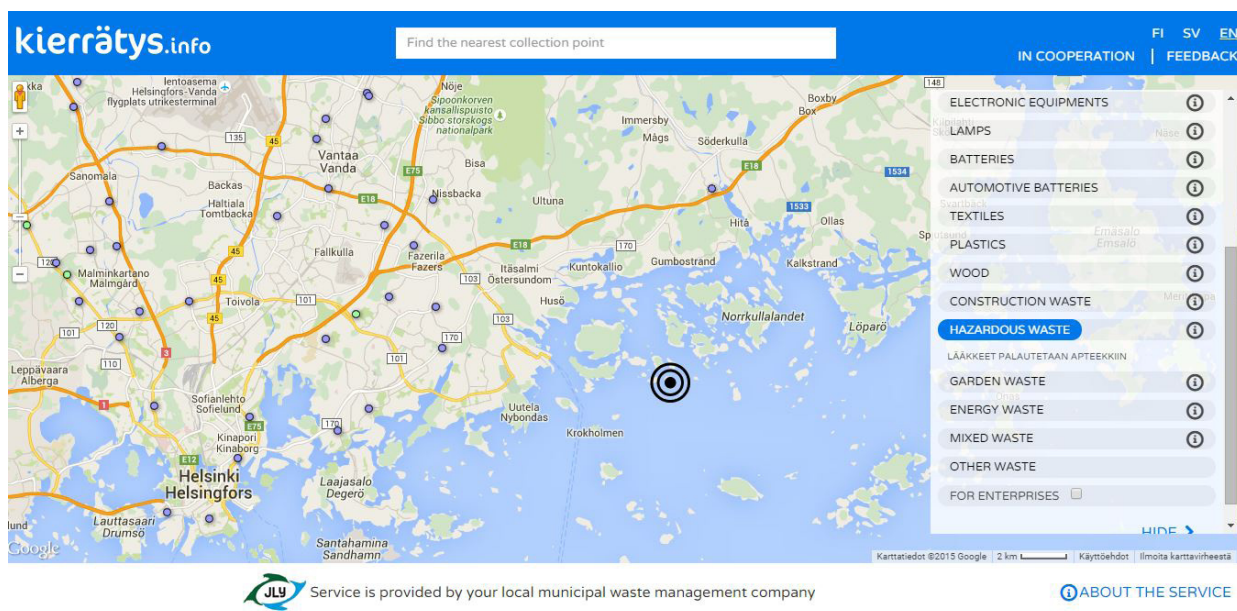


Figure 11. Waste collection points in Finland for various waste types (Source: www.kierratys.info 2015).



Figure 12. "Small but dangerous" (Original in Finnish: "Pieni mutta vaarallinen"; Source: www.vaarallinenjate.fi 2015).

wide platform "Pieni mutta vaarallinen" ("Small, but dangerous"), which includes hosting of a website www.vaarallinenjate.fi, where residents can find guidelines for hazardous waste disposal (Fig. 12). JLY supports its members (waste management companies) with organizing educational campaigns, providing communication materials and supporting them with advertising in local newspapers, magazines and social media (Hämäläinen 2014, pers. com., November 19).

It has been estimated that if Member States recycled 70 percent of all their waste, at least half a million of new jobs would be created across Europe.

European Commission 2010

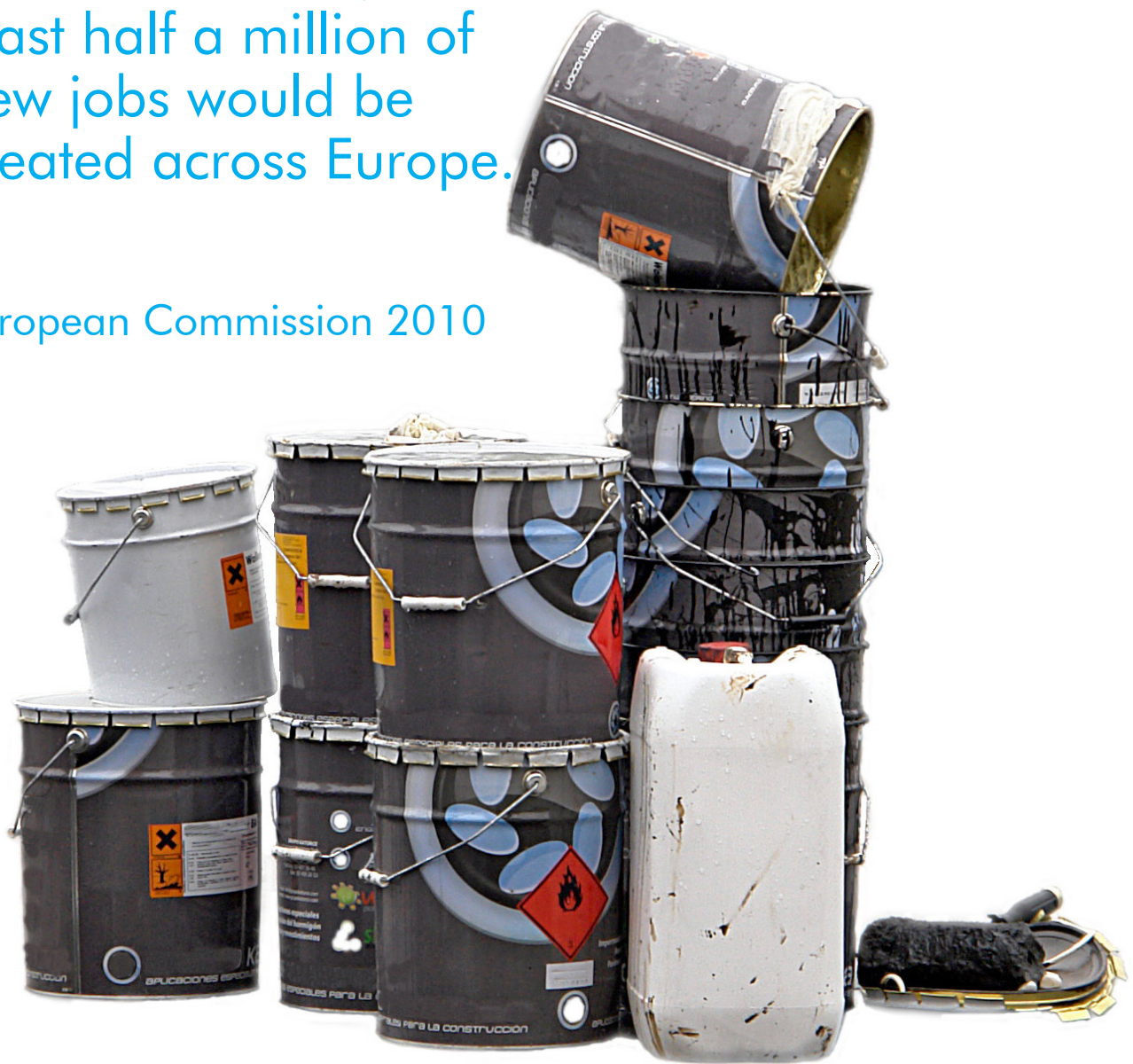


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OBSTACLES AND OPPORTUNITIES FOR CHANGE

Moving towards a circular economy has become an important step that Europe has made to improve its resource efficiency and move towards smarter and more sustainable growth. In a circular economy materials stay within the economic system as long as possible. When the product has reached its end of life phase, it is used over and over again, either as it is originally intended to be used or as a material source for manufacturing other products.

Circular economy implies an entire system change, where not only value chains undergo alteration, but also waste management, consumer behavior and business models. Improved resource productivity has potential to create new markets and bring additional business value. In fact, resource efficiency improvements along the value chains are estimated to decrease 17-24 percent of material input requirements by 2030 (Meyer 2011).

3.1 Change of waste policy and targets

On July 2, 2014 the European Commission adopted a legislative proposal to review recycling and other waste-related targets within the EU Waste Framework. Based on the proposal some of the targets were updated and additional recommendations were given to the member states. Some of the main elements of the proposal include (European Commission 2014):

- Increase of recycling and re-use of municipal waste up to 70% by 2030

- Increase in recycling and re-use of packaging waste to 80% by 2030 with specific targets for plastics (60%), ferrous metal (90%), and other materials
- Better use of economic instruments, such as landfill and incineration tax, pay-as-you-throw schemes, and improved separate collection of recyclables
- Improved traceability of hazardous waste
- Phasing out landfilling by 2025 for recyclable waste

3.2 Moving towards Sustainable Waste Management

With environmental laws and regulations for hazardous waste management getting more stringent, authorities are ready to apply more innovative approaches. In order to have safer and more sustainable waste management practices, authorities often find value in supporting recycling programs (Massawe et al. 2014, p. 29).

For manufacturers of the products, which become hazardous waste at the end of their useful life, sustainable waste management initiatives can be an opportunity to avoid stricter regulations in the future. By acting early enough to organize more flexible and cooperative waste management programs, producers can reduce their long-term expenses and potential liabilities. As an example, coating manufacturers have been taking on responsibility agendas, which are helping them in sustainability metrics and have opportunities for lowering their production costs (Bagaria 2012). In the near future, if the trend continues, we might see even more examples of cooperation between industry organizations, paint manufacturers and the government.

Recycling provides businesses with opportunities and generates more jobs. Solid waste management and recycling industries have a turnover of around €137 billion and create over 2 million jobs. It has been estimated that if Member States recycled 70 percent of all their waste, at least half a million of new jobs would be created across Europe (European Commission 2010, p. 12).

3.3 Company Image

In December 2013 TNS Political & Social Network (2014), a global market research agency, carried out a survey in the 28 Member States of the European Union. Main findings showed that 71 percent of respondents stated that

reassurance that waste had been effectively recycled could convince them to separate more of their waste. It leads us to believe that they were not persuaded that waste, which had been collected after pre-sorting, was actually recycled. Better communication of recycling results could potentially improve waste separation rates and lower the costs of waste management.

When it comes to customer experience, greenwashing is one of the worst things that can affect the trust. When customers support the brand, but later find out that the information they believed was actually not true, they feel betrayed and might discontinue their brand loyalty forever. When companies communicate their efforts towards sustainability, including responsible actions and impact on the environment, they must be able to prove that their statements are truthful.

The Millennial Survey by Deloitte showed that 9 respondents out of 10 thought that it was ok for a business not to be perfect, as long as they were honest about it. The same study showed that consumers tend to distrust corporate communication reports and instead trust more the information that is shared by other individuals, especially people whom they are close with (Deloitte 2014).

3.4 User Experience

Sustainable design and user experience are intertwined concepts. According to Kramer (2012), “sustainable user experience design should exercise the key principles of sustainability and consider its three tangential ideals: economic, social, and ecological sustainability.” Sustainable user experience involves not only the use phase of products, but also its disposal. The end of product life cannot be separated from the system in which it originates.

Kramer (2012, p. 78) writes that a growing number of customers is demanding greener products and solutions. He talks about the benefits of asking questions, which cover more than standard user research (Kramer 2012, p. 81):

- What is the quality of materials?
- How long does the product last?
- Is the product returned to the manufacturer after its usage?
- How is the product disposed of?
- What is the product packaging and how is it disposed of?
- Can the product be reused?
- Are there opportunities to extend the life of a product?

Answers to these questions can form the basis for more sustainable solutions. For example, user research can inquire about what happens with products after their utility is gone. Based on the results, manufacturers can produce the users with options, where instead of buying new products; they can refill, reuse or recycle. According to Kramer (2012, p. 93), extending the useful life of a product might seem contradictory to a company's interest to increase sales. This contradiction can be solved by an independent middle party, such as a non-profit organization, working together with consumers and manufacturers to look for innovative products that simultaneously meet user needs and improve the triple bottom line.

3.5 Customer engagement and communication

Successful sustainable action requires more than business strategy. It needs customer engagement, which, according to Deloitte (2014), is a "characteristic of the successful business of tomorrow." Making sustainable products is not enough if customers are not encouraged to engage with sustainability actions in a meaningful for them way. Deloitte believes that customer engagement needs to be in all stages of a product or service consumption (Deloitte 2014, p. 4).

In fact, many businesses start putting customer engagement in line with sustainable action, because they notice that it improves sustainability performance, and, at the same time, it meets the needs of customers (Deloitte 2014, p. 5). The Millennial Survey on sustainability showed that 8 respondents out of 10 wanted to be engaged in companies' sustainability activities (Deloitte 2014).

The Life Cycle Engagement framework is explained by Deloitte as a collection of efforts aimed at engaging consumers through the entire life cycle of a product (Deloitte 2014, p. 22). This framework covers many customer engagement activities in pre-purchase, purchase, use and discard phases. In case of the leftover paint, customer engagement in the discard phase of a product (how, when and where consumers discard paint products) increases customer trust to a paint manufacturer and elevates the product value.

3.6 Financial Incentives

Many European countries use incentive schemes for residual waste, offering lower charge for recycling. During the survey by TNS Political & Social Network (2014) 59 percent of respondents mentioned financial incentivization as a potential motivator for separating more of their waste.

Waste Watch, a non-profit organization promoting sustainable resource use, lists the following types of financial incentives (Eunomia Research & Consulting

2011, pp. 85-87):

- Variable charging for waste collection and disposal service (based on weight and volume)
- Deposit-refund schemes (point-of-purchase fee is refunded)
- Receiving a payment for recycling (collecting points for setting out recyclables for collection)

Even though incentives are usually accepted with enthusiasm, CIWM, the Chartered Institution of Wastes Management, expresses their concern about incentives for recycling, because they see that it can encourage higher waste amounts (more material – more rewards) (Eunomia Research & Consulting 2011, p. 11). In order to monitor effectiveness of incentivization scheme, an information database might be a useful instrument.

AMDEA, the UK trade association for large and small domestic appliances, believes that the best way to motivate most people to recycle is to make it simple, convenient and consistent with their already existing life arrangements (Eunomia Research & Consulting 2011, p. 76).

Some critics of incentivization believe that it wastes tax payers' money without changing the situation with recycling. Robert Williams, Hillingdon Waste Development Manager, thinks that the key consideration is whether the cost of incentive scheme for recycling is greater than the avoided cost of waste disposal. In addition, there is a level of uncertainty whether incentive schemes bring long-term behavioral change (Eunomia Research & Consulting 2011, pp. 6-7).

3.7 REACH (EU Chemical regulation)

The Registration, Evaluation, Authorization & Restriction of Chemicals (REACH) has been requiring industry to assess and manage the risks from chemicals, and provide safety data to the users. According to ECHA (European Chemicals Agency), REACH regulation was adopted by the European Union in order to improve the protection of human health and the environment from the risks that might be caused by chemicals. Another purpose of REACH is to support competitiveness of the EU chemical industry. (ECHA 2015).

Although REACH regulations do not cover waste (Linher 2009), it affects recycled products, which use secondary raw materials extracted from waste (recovered substances, which used to be waste materials, but later changed their classification and ceased being waste). For example, re-manufactured paint is one of such products. Wobbe van der Meulen believes that REACH regulations might make it difficult for recycling companies to comply with the

regulations, which is holding back the EU's intention to minimize virgin material consumption (EurActiv 2015). If you recycle to the end-of-waste status (recycled materials are reclassified and are no longer considered to be waste) and make a product, which goes to the EU market, you have to comply with REACH regulation. Unlike a traditional chemical production, where virgin material inputs are clearly defined, a recycling production has a variety of input compositions coming from post-consumer waste (Frédéric 2012). Recycled products become more constrained than products using primary substances and the position that they take on the market cannot be called 'fair.'

According to Benoy et al. (2014), coatings industry has been considering REACH as a "barrier to the development of paint remanufacturing," because regulations restrict reuse of chemicals if the exact origin and content of the material is unknown. It is typical that collected post-consumer paint might be missing labels. It might be difficult to know the exact content of a paint can, because additional substances could have been added by the consumer. Therefore, recycling industry is more relying on quality controls (Frédéric 2012).

CHEM Trust argues that there is no contradiction between the aim of REACH and the aim of increasing recycling, because sustainable recycling requires that hazardous substances are not recirculated in the society (Warhurst 2015). In case of paint, every batch of recycled paint cannot be analyzed for practical and economic reasons. Thus, there needs to be a "pragmatic way to ensure that a specific batch of secondary raw material does not contain substances of very high concern" (Frédéric 2012).

3.8 Green Building Assessment Systems: LEED and BREEAM

The building sector has been identified as one of the main factors of greenhouse gas emissions. It constitutes approximately 44 percent of the total material use and roughly one-third of the total CO₂ emission (Li 2006). Environmentally responsible procurement policies can significantly reduce the negative impacts that building causes starting from its construction, through operation and finally during the demolition phase.

Sustainability assessment systems, such as BREEAM and LEED, should be rewarding reuse of materials and using of the materials with recycled content. The main reason behind it is that recycled content reduces the need for virgin materials and discourages the increase of waste volumes. On practice, the role of materials with recycled content, such as paint, remains to be at the minimum in construction industry.

The LEED Green Building Rating System provides minimum performance

standards for various sustainable building elements, including paint. According to USGBC, US Green Building Council's Leadership in Energy and Environmental Design, LEED gives Green Building credit for those types of paint that meet the VOC and chemical component requirements. Using recycled paint may qualify under the following categories of LEED (2015):

1. Low-Emitting Materials (IEQ Credit 4.2)
2. Recycled Content 25% (MR Credit 4.1)
3. Local/Regional Materials, 20% Manufactured Locally (MR Credit 5.1)

One of the purposes of these credits is to stimulate recycling market and increase demand for those building products that have materials with a recycled content.

BREEAM, the Building Research Establishment Environmental Assessment Method, is the world's first environmental rating system to assess the sustainability of buildings (Ebert et al. 2011). According to Norfolk County Council, "BREEAM seeks to minimize the adverse effects of new buildings on the environment at global and local scales, while promoting healthy indoor conditions for occupants" (Norfolk 2015). Credits are awarded in different categories according to performance, and eventually are added together to produce a single score.

Keith Harrison, managing director of Newlife Paints, mentioned in the interview that BREEAM actually did not grant credits for using a recycled paint. The reason behind it is that paint has not been considered to be one of the main building elements, because it is applied later after the construction has already been completed. Because of that the use of recycled paint in BREEAM can neither receive Mat 01 credit (Life Cycle Impacts: construction materials with a low environmental impact) nor Mat 03 credit (Responsible Sourcing of Materials). The reason behind it is that even though recycled paint production from waste paint is considered responsibly sourced by default, it is not a structural material, neither it is a material for key building elements.

Keith Harrison (pers. com., December 22) believes that the situation needs to be changed: "If you are using a recycled material, then you should be getting an allowance that you are using a low-carbon material". What happens now is that a building commissioner of a green certified building does not receive carbon credits for using recycled paint. Because of that he or she doesn't have a motivation to change anything, preferring rather to stay with a current supplier.

3.9 Eco-label Schemes

Eco-label schemes are developed to identify products and services produced

in accordance with the specific environmental standards. Voluntary labels are used as marketing tools in some of the EU states, while mandatory labels (also called green stickers) are required by the legislation. Eco-labels are sustainability measurements, which are directed at consumers to make their environmentally-conscious purchasing decisions to be easier.

The European Eco-label (EU Flower) is used for many everyday consumer products (total of 27 different product and service categories), including recycled paint. It helps consumers in the European Union to identify officially approved, based upon life cycle considerations, green products. Other nationally used labels include the Nordic Swan and the German Blue Angel (Fig. 13).

Figure 13. Eco-labels. From left to right: EU Flower, Blue Angel, Nordic Swan (Source: Ecolabel, Der Blaue Engel, Nordic Ecolabel).



The problem with different eco-labels is that they are not always relevant in other countries. For example, the German Blue Angel is not taken into account by the British consumers. Another aspect is the large amount of work and investments that it takes for companies to receive an eco-label. For small environmentally-oriented businesses pursuing an eco-label might be not possible because of the resource shortage.



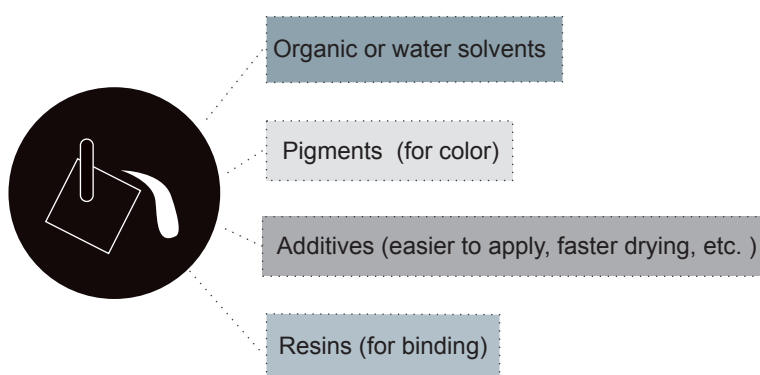
Paints are the products that are commonly found in households, with the significant portion of it remaining unused and, after a period of storage, being disposed of.

Gendebien et al. 2002

Image source: www.o-vannoy.ru

PAINT

Households use paint products for different applications: in house, garden, interior and exterior home repair, hobbies, etc. According to Gendebien et al. (2002, p. 72), the largest use of paint is on interior walls, ceilings and woodwork painting and decoration inside and outside the house.



Paints are mixtures of solvents, pigments, resins, and various additives (Fig. 14). Solvents are various low viscosity volatile liquids, which are used in paints to make its application easier by keeping it liquid. However, organic solvents release VOCs (Volatile Organic Compounds) that persist in nature and possess significant human health risks.

Figure 14. Raw Materials in Paint (Source: Gendebien et al. 2002).

(Volatile Organic Compounds) that persist in nature and possess significant human health risks.

Pigments give color to paints and can be either of mineral or organic origin. With lead, cadmium and chromium banned in decorative paints, pigments, apart from copper, are relatively non-hazardous. Nowadays there are hundreds of different pigments available, both of natural and synthetic origin.

Resins act as a binder forming the paint film, which gives flexibility, hardness and durability to the coating. Resins come from vegetable sources, such as linseed oil, or from crude oil.

Additives in paints help to disperse pigments in resins, improve hardening process, and protect it from a biological attack. Additives can also serve other functions, and be hazardous for human health and environment due to its

content. (Gendebien et al. 2002, pp. 71-72).

Because of the paint content, it is important that management of leftover paint supports sustainable development. TNS four sustainability principles indicate that concentrations of substances extracted from the earth's crust and those produced by society cannot be increased in an uncontrolled manner. The principles also indicate the need to prevent systematic degradation of nature and, caused by it, health effects.

4.1 Paint Market

Paint has been an important part of the global economy for over 30,000 years. The A&D paint segment is the largest single component of the coatings industry. According to IPPIC (International & Printing Ink Association), in 2011 A&D segment was around 56% of the global coating industry's total volume; and for the past five years, global decorative coatings' volume has grown at an annual rate of 3.4% (IPPIC 2012, Chapter 1, 1.6). According to Frost & Sullivan (cited in Bagaria 2012), paint volumes in Europe have grown by 21 % in 2014 in comparison with 2009 (Fig. 15). Current demand for paint in Europe, according to IPPIC, is almost 8 liters per person per year.

Freedonia Group Inc., a research firm based in Cleveland, USA, explained the reasons behind a rising demand for paint products. According to their research, it is based on the world's growing urban population, which leads to increase in both private, public construction (Freedonia 2006), and renovations of the existing housing stock.

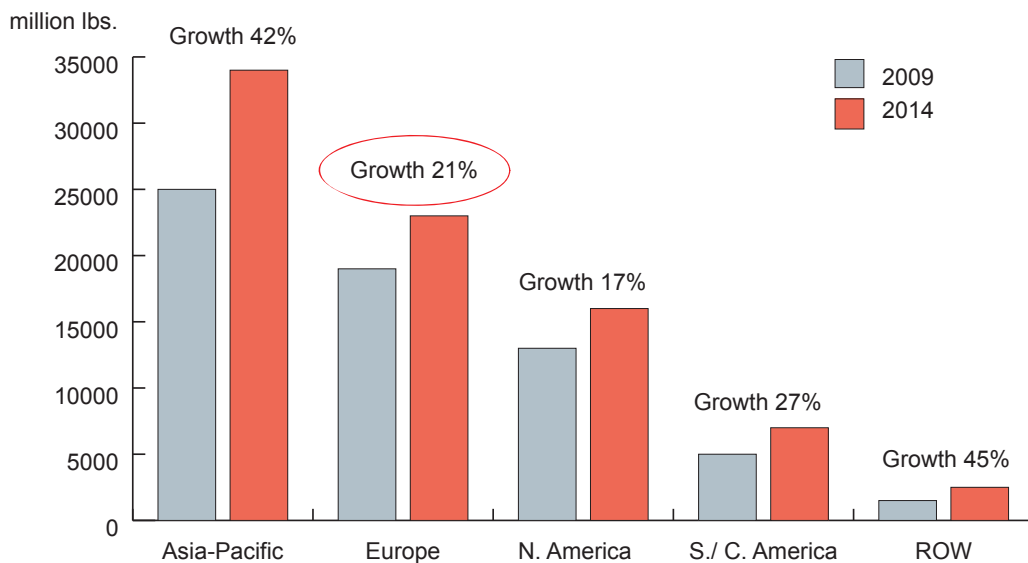


Figure 15. Trend for paint volume growth by region (Frost & Sullivan cited in Bagaria 2012).

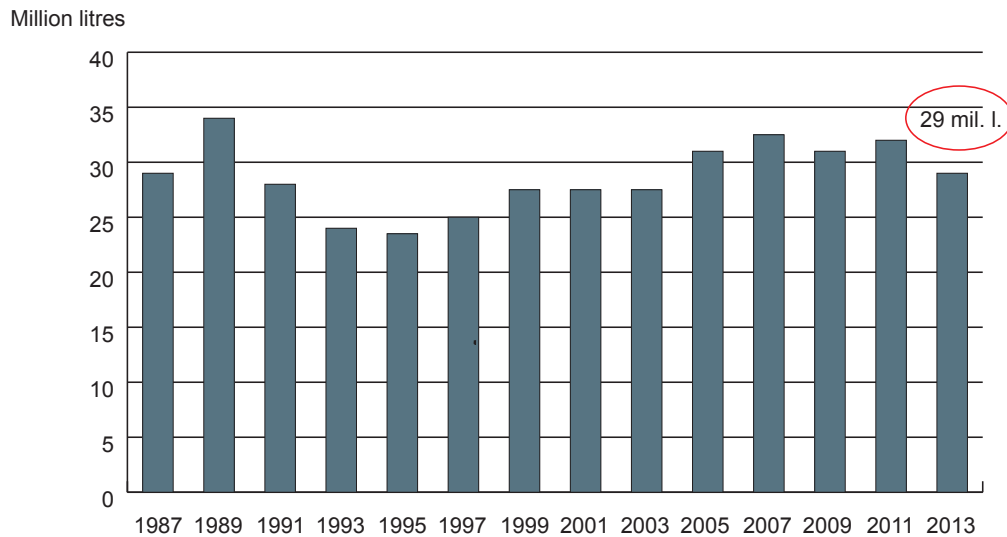


Figure 16. Sales of decorative paints by volume in Finland (Source: VTY Vuosigraafit 2013).

The decorative paint market includes both DIY clients and professional painters. According to the comments from Juha Pyötsiä, managing director of Värитеollisuus, Association of Finnish Paint Industry and Printing Ink Companies, in Finland 60% of all the decorative paints are bought by the households and remaining 40% by professionals (Pyötsiä 2014, pers. com., 5 December). Following this estimation, in 2013 out of total 29 million liters of sold decorative paint in Finland; 17.4 million liters of it were bought by households and 11.6 million liters - by professional users (Fig. 16).

4.2 Types of A&D Paint

A&D paint includes solvent-borne and water-borne coatings. According to Gendebien et al. (2002, p. 71), solvent-borne paints contain organic solvents that keep them liquid, making them easier to apply. The main concern with the solvent-borne paints is that they release VOC's (Volatile Organic Compounds). VOC's are known to be responsible for health problems and are associated with greater risks to the environment.

Water-borne paints, also called as latex paints, have a low or zero VOC emission content. They are known to be low odor and have easy clean-up requirements. The demand for water-borne products has been growing consistently and by 2012 water-borne paint had represented 82% of the global demand for A&D coatings (IPPIC 2012, chapter 1, 1.14).

4.3 Leftover Paint

According to the 2002 European Commission report, paints are the products that are commonly found in households, with the significant portion of it remaining unused and, after a period of storage, being disposed of (Gendebien et al. 2002). Main risks associated with paint come from the use and the end-of-life stages (Gendebien et al. 2002, p. 24-25).

VOC emissions, originating from the presence of solvents in paints, possess one of the biggest risks. Other significant risks are associated with paint brushes and containers being washed in the sink and leftover paint flushed down the drain or storm sewer due to its toxicity. To avoid contamination of waste streams and leachate, liquid paint should never be thrown in mixed waste.

Considering that management of waste paint represents “significant and increasing cost for local household hazardous waste management programs” (Global PSC 2013, p. 4), it would be wise to search for alternative paint management practices. In addition, over the past five years “manufacturing and material costs have increased at a rate over 50 percent higher than that of average decorative coatings’ price increases” (IPPIC 2012, Chapter 2, Section 2.5).

With rapidly rising raw material and energy costs, waste paint might become a salable material in the near future. Demand for recycled paint, for example, can go beyond the European market and be potentially marketed in Asia Pacific, Latin America and developing countries in Africa. Developing markets have larger share of “good” quality paint in comparison with Europe and North America with their primary market in “better” and “best” quality A&D paint sales (IPPIC 2012, Chapter 2, 2.7).

4.4 Consumer Behavior

With an increasing demand for water-borne products, composition of hazardous waste and its treatment have been affected as well. Using separate approaches for management of water-borne versus solvent-borne paint might be more effective than mixing all waste paint together and sending it for energy recovery. Reuse and recycling of latex paint can lower the demand for valuable materials. At the same time, energy recovery of solvent-borne paint apart from latex paint can become more efficient, due to its higher energy content and lower amount of water in the burned mix.

While approach to final management of waste paint can change, it is important to remember that behavior of consumers at the end of a product’s life cycle is very important for making the system more sustainable. For example, there are number of things that users are typically advised to do with the liquid latex paint, such as drying it with cat litter, adding paint solidifier or keeping the lid off to let it dry. Drying and solidifying paint should be done in a well-ventilated area,

preferably outside in warm and dry weather. However, drying paint is usually too complicated and time-consuming. Marjaneh Zarrehparvar, a managing director of PaintCare USA, has learned that even in those states, where paint disposal instructions have been in use for 20 years, the majority of the paint users still do not dry it: "It's such a pain and it's messy. They don't want their kids or dogs to get into it." As a result, people hung on to paint for years, knowing that they shouldn't throw liquid paint into mixed waste trash, but not knowing exactly what else they could do with that (Zarrehparvar 2015, pers. com., January 2).

Gendebien et al. (2002, p.26) came to the conclusion that individual users tend to store containers with leftover paint for a number of years in large quantities. In order to get rid of obsolete or gone-bad products, they may discard them all at once into waste streams, creating a high risk for the environment and human health. Considering that packaging and labeling of paint products can deteriorate with age, it might also be difficult to identify exact content of the paint containers.

Based on the outlined risks, it is essential to give DIY users and professional painters a convenient service that motivates them to return leftover paint in a timely manner. Based on the results of the study on household hazardous waste, the European Commission recommended ensuring that half-empty paint cans do not get discarded into the main solid waste collection streams by keeping a separate collection of paint and re-using it whenever possible (Gendebien et al. 2002, p. 74).

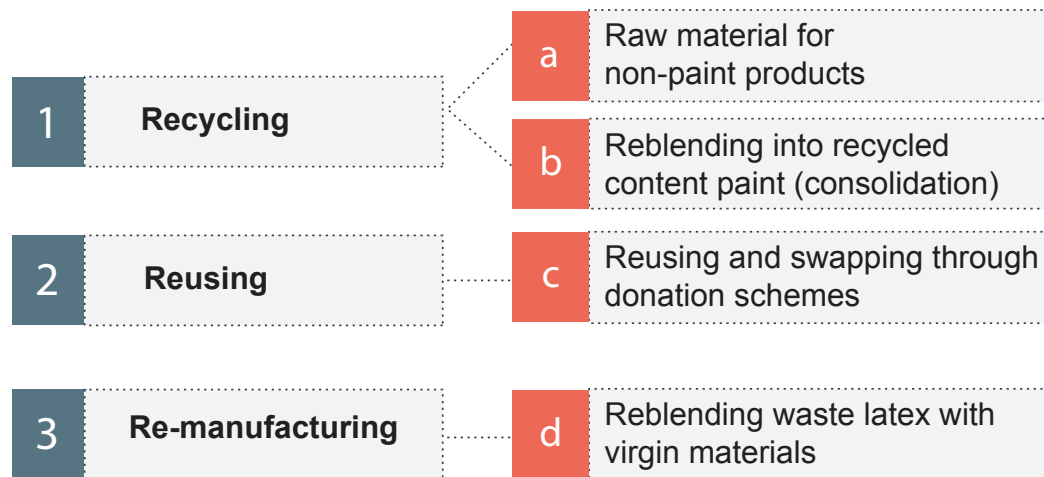
4.5 Options for Sustainable Management of Waste Paint

Having a hazardous classification, paint waste is often associated with a stigma that it must be burned or buried to avoid potential health and environmental risks. Using paint waste and avoiding permanent loss of valuable materials might sound unrealistic. Despite the general misunderstanding, there are several existing options for sustainable management of post-consumer paint. This chapter describes paint recycling, its reuse and re-manufacturing options (Fig. 17).

Among some of the benefits of sustainable paint waste management, as opposed to either landfilling or energy recovery, are reduction of negative impacts on the natural environment and carbon savings for new construction and existing building renovation.

Recycling of Paint

Figure 17.
Options for
sustainable
paint waste
management.



The process of paint recycling means that waste latex paint (WLP) is not altered and used as raw material for the final product. WLP can be used as a raw material for manufacturing of non-paint products, such as non-structural concrete and plastics, or re-blending it into a 100% recycled content paint (Benoy et al. 2014, p. 64).

WLP in non-paint products

According to Nehdi and Sumner (2003), paint can be recycled in concrete manufacturing in two different ways: as a partial replacement for fresh water or as a partial or full replacement of polymers used in certain types of concrete. Quiroz (2011) states that if water is partially replaced with the waste paint, concrete exhibits superior properties, such as smoother finish, enhanced workability, lighter and more reflective color, as well as no signs of surface scaling or coarse pop-outs. According to Chemsal, a company treating industrial waste for resource recovery, waste paint in concrete delivers up to 10 percent in water savings (EPA Victoria 2011).

Paint can be also recycled as a replacement of polymer in concrete. According to Quiroz (2011) and Houshamand et al. (2013, p. 22), it can make this product more cost-effective and improve its positive properties. Latex Modified Concrete (LMC), which is used for protective layer of bridge roadways, a significantly reduced cost of manufacturing if virgin latex gets replaced with waste paint. Waste paint can also be used in pervious concrete manufacturing as a replacement of latex additive, which strengthens the final product.

Studies have been carried out on the application of WLP in masonry blockfill mix, both as a partial water replacement and as a polymer admixture replacement. According to Haigh (2007), the results showed that using WLP helped to improve workability and maintain strength of the blockfill mix.

It is essential to notice though, that concrete performance has been found to

decrease with the addition of too much WLP, which makes it very important to investigate what blending ratio should be used for the best results (Quiroz 2011). Quality monitoring is not an easy task, considering inconsistencies of WLP properties. The process of monitoring of polymer and water ratios makes the production of concrete and masonry blockfill mixture complicated and brings additional manufacturing costs (Houshamand et al. 2013).

Another use of WLP can be in the production of plastics. According to Stoye and Freitag (1998, pp. 271-272), paint coagulates can be used as a binder for molded plastics, and as a filler replacement for plastic dispersions, such as underbody protection on automobiles and sealing materials. Lynch et al. (2010) have used WLP as polymer feedstock materials for non-paint materials, such as polyethylene thermoplastics (used for manufacturing pipe fittings, trays, tanks and cutting boards); and for transparent thermoplastics (used for manufacturing of Plexiglas, skylights and aircraft). However, it is noted that the research of using WLP in plastic production has been limited (Lynch et al. 2011) and additional investigation is recommended.

Another application of waste latex paint can be in composites applied to low slope Roof Membrane Systems, which increase puncture and fire resistance and reduce risk of roof leakage (Nehdi and Soliman 2012). Experiments showed that using leftover paint in the production of roofing systems can consume large volumes of hazardous waste. Using waste latex paint results in significant economic benefits for both waste management companies, who reduce the costs of hazardous waste disposal, and roof manufacturers, who receive a low-priced or even free material. Environmental benefits include reduced level of the dispersal of persistent compounds into the environment. However, due to small scale and limited trials of WLP use in roof membranes, more research is recommended (Houshamand et al. 2013).

Options for using WLP in non-paint applications are listed in the table below (Fig. 18). Opportunities and obstacles associated with using each of them are listed based on the reviews of the research literature and expert opinions. Production of non-structural concrete has been researched and tested more than other applications. For other cases it is still necessary to conduct complimentary studies in order to establish more defined ratio of WLP and perform more investigation to address local requirements, including product certification and quality standards.

Other applications of waste latex paint, such as using paint for production of latex asphalt sealant, decorative ground landscape cover or alternative daily cover for landfills have not been considered in this research. The main reason for this is an associated with it higher chance of chemicals leaching into the environment.

It is important to note that adding paint as either a replacement of water or polymers, can affect recyclability of the final materials. However, no research

Figure 18.
Options for
using WLP
in non-paint
applications.

| WLP APPLICATIONS | OPPORTUNITIES | OBSTACLES |
|--|--|--|
| Non-structural concrete a) Partial replacement for fresh water b) Partial or full replacement of polymers | Reduced water consumption in production and cost of manufacturing in comparison with using virgin latex (Quiroz 2011); Superior properties: smoother finish, enhanced workability, lighter and more reflective color, no signs of surface scaling or coarse pop-outs (Nehdi and Sumner 2003); Partial water replacement improved long-term durability (Mohammed et al. 2008); Reductions in carbon footprint in the concrete industry (Houshamand et al. 2013). | In some stages of the tests, concrete performance was found to decrease with addition of more WLP. This fact requires additional investigation in mixture blending ratios (Quiroz 2011); Inconsistency in WLP mixtures results in variability in properties of a final product; Continuous quality monitoring of WLP in terms of percentage of water, pigment and polymer makes the process complicated and costly (Houshamand et al. 2013). |
| c) Replacement of latex additive in pervious concrete | Improved strength of a final product (Quiroz 2011). | |
| Masonry blockfill a) Water replacement b) Replacement of polymer admixture | Maintained strength and improved workability (Haigh 2007); Recycles large amount of WLP; Reduces cost of manufacturing and resource consumption (Houshamand et al. 2013). | |
| Plastics | Reduced cost of manufacturing in comparison with using virgin binders and fillers; Enhanced mechanical properties (Lynch et al. 2011); Reduced carbon footprint (Houshamand et al. 2013). | Application of WLP in plastic production has had limited research (Lynch et al. 2011). |
| Roof systems | Increased puncture and fire resistance, reduced risk of roof leakage (Nehdi and Soliman 2012); Environmental benefits: consumes large volumes of WLP; Significant economic benefits (Houshamand et al. 2013). | Solution has been implemented in limited trials; More investigations are required to address local authorities' specifications; Currently low market demand (Houshamand et al. 2013). |

has been found in this area.

WLP consolidation

Recycled paint contains 100 percent of post-consumer paint. Waste paint is sorted by type, color and sheen, filtered and blended. According to EcoPluss (2014), for every gallon (or 3.8 l) of blended paint used instead of virgin paint, approximately 100 kWh of energy and 52 kg of CO₂e (greenhouse gas equivalent) are saved.

In order to achieve quality control, only good quality paint is used for the production of recycled paint. According to McMaster (2003), the process of paint consolidation is typically performed on the collection site to reduce storage and transportation costs. In addition, volunteer labor is sometimes used for sorting and blending paint to further reduce production costs. The disadvantage of it is a higher possibility of occupational health and safety risks, associated with volunteers handling hazardous waste materials (Houshamand et al. 2013).

Consumers benefit from recycled paint by paying lower prices for the quality paint, which, according to paint recyclers, is almost as good as the virgin paint (Ecopluss 2013). Some of the disadvantages of 100 percent recycled paint include limited color selection and sheen availability. Even though the quality of the recycled paint is good, it is important to add that in some cases it is still lower than of the virgin paint.

For these reasons recycled paint is frequently used by non-profit community and municipal groups for housing improvements, graffiti cover up and beautifying urban projects (Legacy Paints 2015).

Reusing of Paint

According to the waste management hierarchy, the most sustainable option for WLP (after trying to avoid the waste) is its reuse in the originally intended application. Unused and leftover paint in good condition can be collected and donated to community groups, non-profit organizations, educational youth programs and art projects.

McMaster (2003) and Greiner et al. (2004) have estimated that on average 8 percent of the waste paint cans are in good condition and are either full or almost full. Paint reuse programs help to avoid unnecessary waste of post-consumer paint, as well as significantly reduce expenses for those social programs that have limited funding.

There are several examples of paint reuse schemes in the world. One of the examples is Community RePaint, which is a working system for donation of

leftover paint to community organizations in the UK (Communityrepaint.org 2015). Later in chapter 6 Community RePaint is presented in a more detailed form.

Similar to an established Community RePaint scheme, Sustainable Beauty is a donation scheme managed by the paint manufacturer Tikkurila in Finland. Leftover paint (from manufacturing mistakes, retail returns, changes in packaging design and labels) is donated every month to local community and educational organizations. Receiver organizations apply for paint through a manufacturer's website with a description of a project where they are planning to use donated paint.

The benefits of reusing leftover paint include minimizing hazardous waste amounts and supporting social initiatives, which otherwise would not be possible to achieve. The schemes typically do not include high transportation expenses and do not require energy for reprocessing. However, a need for sorting; health, occupational and environmental risks; uncertainty of demand and difficulty of matching it with appropriate supply of paint are the main disadvantages, associated with running paint reuse schemes (Houshamand et al. 2013, p.16).

Re-manufacturing of Paint

Re-manufacturing paint differs from paint consolidation. It involves adding 10-30 percent of virgin raw materials, such as limestone, clay, marble or other minerals to post-consumer latex paint (Legacy Paints 2014). Adding virgin materials allows manufacturers to achieve more superior qualities than those of 100 percent recycled paint options. Some of the advantages include greater color variations, sheen and pH consistency. Certainly with a greater quality come greater efforts of sorting, filtering and testing of paint, which add up to the costs of the final product.

Re-manufactured paint carries all the environmental benefits by replacing the need to manufacture as much new paint, reducing the need for virgin raw materials and production of energy, minimizing pollution and amounts of hazardous waste. Being beneficial for the environment, remanufactured paint can be certainly considered as an eco-friendly choice of paint.

According to the British Coatings Federation (BCF), remanufactured paint has a carbon footprint that is 50 percent lower compared to virgin manufactured paint. For example, one of the raw materials used as whitening in paint production, Titanium Dioxide, contributes to 70 percent of the carbon footprint of virgin paints and is the most valuable mineral in the production of paint. (Benoy et al. 2014, p.63). Other minerals, such as limestone and clay, even though not being scarce, are nevertheless extracted from nature and are not renewable if

burned during incineration or landfilled.

The production of remanufactured paint in the UK, however, currently equals to only 1 percent of the total paint volume sold each year in the country and is done mostly by micro-SMEs (Benoy et al. 2014, p. 64). Newlife Paints Ltd is a company that re-manufactures post-consumer paint in the UK. Despite of waste paint value, re-manufactured paint sales present a low share of the paint market. It can be explained by a customer's uncertainty, their lack of confidence in re-manufactured paint and unawareness of product's high quality. According to Keith Harrison, "most people are happy to give you waste paint, particularly if it's in their shed, garage or the garden. But when it comes to buying [re-manufactured paint], the reality is that people are in vain, they are not sure whether they can get a good quality. Unless it is quite cheap and they get a good price, they would rather buy new" (Harrison 2014, pers. com., December 22).

According to Benoy et al. (2014), the issue of market reluctance and marginal sales of re-manufactured paint can be solved by a better national communication and a certification label added to the re-manufactured paint products. In the USA, for example, public procurement is a support mechanism for the recycling industry. Re-manufactured paint has been used for painting some of the most prominent sites, such as the halls of the Pentagon, the California State Capitol Building and the EPA office in New York City (Legacy Paints 2014). During a phone interview with Keith Harrison from the UK, he suggested that raising the profile of re-manufactured paint could be achieved if the government would require its departments to specify at least 10 percent of the recycled product for construction projects (Harrison 2014, pers. com., December 22).

4.6 SWOT analysis

Drawing from the above analysis of the options for sustainable waste management, this section provides a SWOT assessment (Strengths, Weaknesses, Opportunities and Threats) of the existing options of paint waste management (Fig. 19, 20). A summary of the key characteristics of the each option helps to identify strategic capabilities for its further development.

a Raw material for non-paint products

| | |
|---|---|
| S trengths <ul style="list-style-type: none"> - New product offering - Low investment requirements - Wide range of applications - Reduced carbon footprint - Low sorting requirements | W eaknesses <ul style="list-style-type: none"> - Requires dedicated facilities and additional permits - Weak market for waste latex paint - Continuous quality testing and associated costs |
| O pportunities <ul style="list-style-type: none"> - Supports circular economy - Minimizes waste management fees and amount of reported waste | T hreats <ul style="list-style-type: none"> - Low demand leads to high costs - High technical risks due to early research stages - Health accidents and spillage risks |

b Reblending into recycled content paint

| | |
|---|---|
| S trengths <ul style="list-style-type: none"> - New offering to customers - Reduced carbon footprint - Low resource and energy demand | W eaknesses <ul style="list-style-type: none"> - Need for training and additional staff - Low volume of high quality paint - Requires dedicated facilities - Sorting expenses - No stable market for recycled paint |
| O pportunities <ul style="list-style-type: none"> - Access to mid-quality market with first-mover advantage - Government support and initiatives | T hreats <ul style="list-style-type: none"> - Competition with own brands - Reputation: lower quality perception - Health accidents and spillage risks - Possible bacterial infection and lack of warranty |

Figure 19. SWOT analysis of the EoL options for paint (Option A and Option B).

c

Reusing of paint program

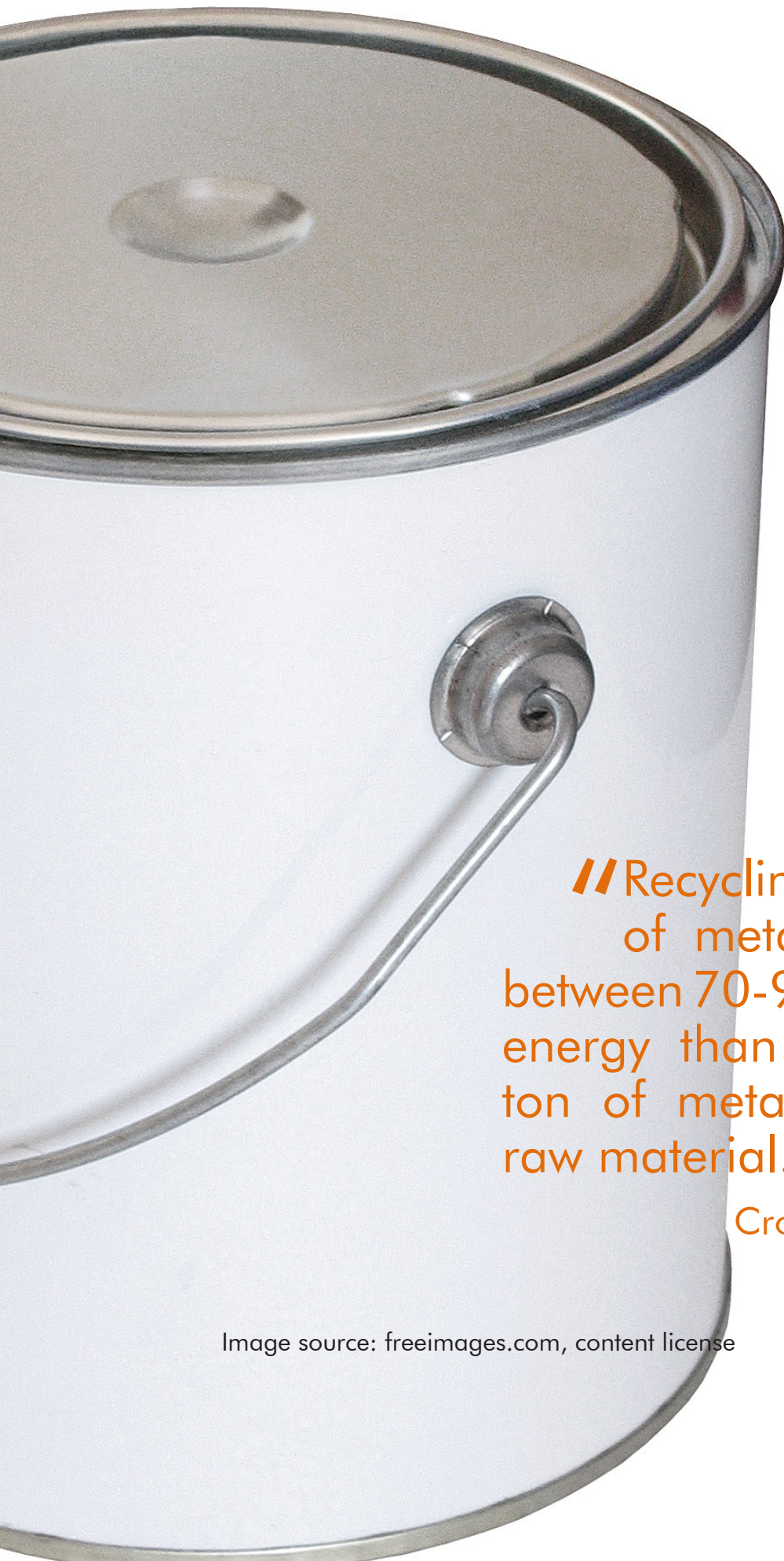
| | |
|---|---|
| S trengths <ul style="list-style-type: none"> - Brand value support - Low investment requirements | W eaknesses <ul style="list-style-type: none"> - Need to be staffed appropriately - Low volume of high quality paint - Requires dedicated facilities - Sorting expenses |
| O pportunities <ul style="list-style-type: none"> - Source of social marketing - Supports corporate responsibility efforts - Competitive advantage - Increases community awareness | T hreats <ul style="list-style-type: none"> - Large amounts of leftover paint due to overstocking - Health accidents and spillage risks - Possible bacterial infection and lack of warranty |

d

Reblending waste latex paint with virgin materials

| | |
|--|---|
| S trengths <ul style="list-style-type: none"> - New offering to customers - In-house product expertise (if manufacturer-operated) - Additional revenue | W eaknesses <ul style="list-style-type: none"> - Significant investments - Need for training and additional staff - Dedicated facilities and permits - Continuous laboratory testing and quality control - Weak market for remanufactured paint |
| O pportunities <ul style="list-style-type: none"> - First-mover advantage - Government support and initiatives - Savings in resources and energy | T hreats <ul style="list-style-type: none"> - Competition with own brands - Health accidents and spillage risks |

Figure 20.
SWOT analysis
of the EoL
options for
paint (Option C
and Option D).



// Recycling one ton of metal scrap uses between 70-95 percent less energy than making one ton of metal from virgin raw material."

Croasdell et al. 2015

Image source: freeimages.com, content license

PACKAGING

It sounds like a common sense that paint belongs to the wall, but at the end of the day some of it is always left in the bucket. Solving the problem of waste paint is not possible without considering its packaging. Leftover liquid paint, even in small amounts, prevents recycling of some paint containers and brings additional expenses to recyclers.

Typically paint is packaged in two different types of containers: metal or plastic. According to waste management guidelines, published by Ekokem, containers with liquid leftover paint should be delivered to hazardous waste collection points (Heinonen 2000). Metal packaging with a small amount of dry latex paint should be delivered to metal recycling collection points. Plastic packaging with dry latex paint can be put in energy waste containers.

5.1 Metal packaging

The metal packaging industry takes pride of its high recycling rates. On its website Metal Packaging Europe claims that their product is low carbon, resource efficient and can be infinitely recycled (Fig. 21) and used for new packaging or manufacturing of other products without loss of its properties (Metal Packaging Europe 2015).

The European Union has committed to a recycling rate of metal at the level of 90 percent in 2030 (Metal Packaging Europe 2015). As calculated and verified by the independent institute Eunomia, already in 2011 the consumer metal packaging recycling rate for the EU has reached 73 percent (Linde 2015), which shows that the European Union targets for recycling are realistic and possible to achieve.

In Finland, according to the official statistics from PYR (2015), the Environmental

Register of Packaging, the total recycling rate of metal packaging in 2012 was 83 percent including PALPA's deposit AL-cans (non-deposit metal package recycling was 74 percent) (Fig. 22).

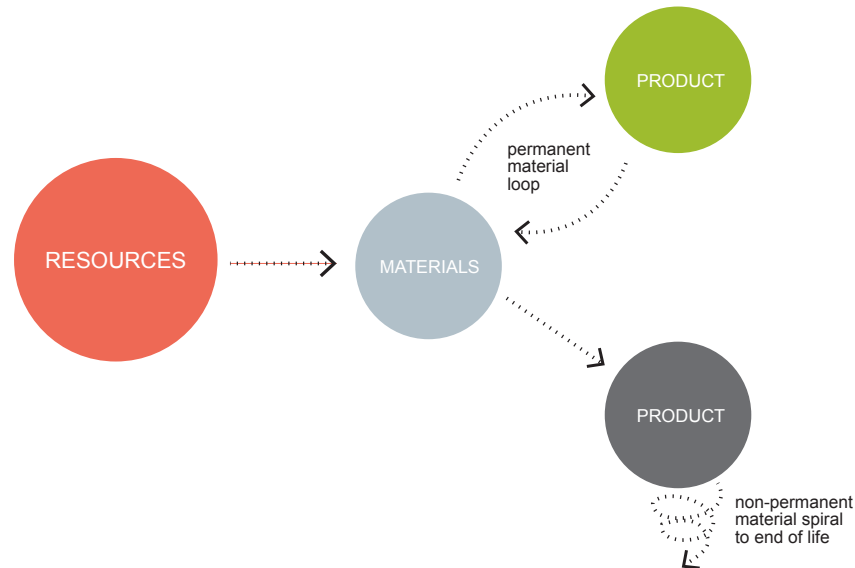
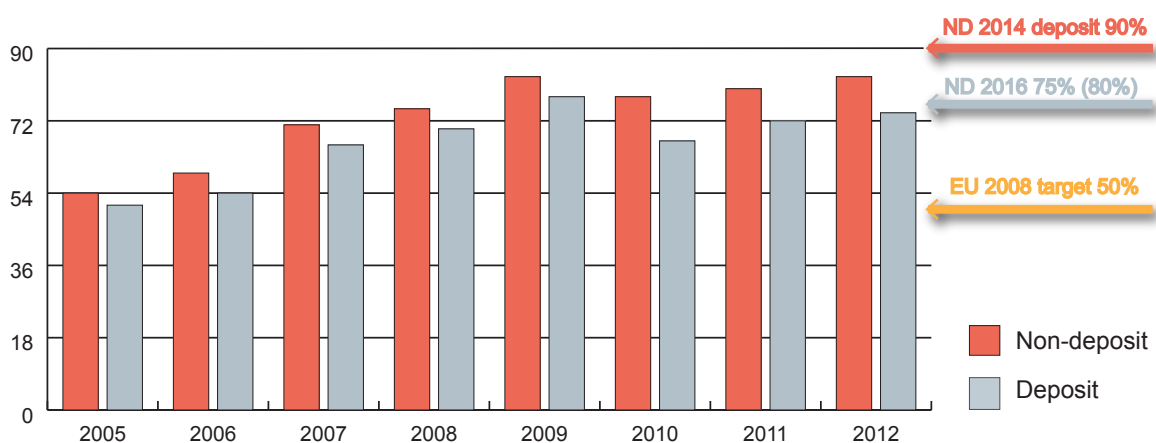


Figure 21. Metal, a permanent material (Source: Metal Packaging Europe 2014).

Tapani Sievänen, managing director of the metal packaging recycling organization Mepak-Kierrätys, explains that in Finland metal packaging is not only recycled from regular collection points, but also from municipal mixed waste and hazardous incinerated ash mixture. Metal is collected from bottom ash by means of a multi-step separation. After that, recovered metal is sent for recycling (Sievänen 2015, pers. com., January 12).

Figure 22. Recycling of metal

packages in Finland 1999-2012 (Source: Metal Packaging Europe 2014). Metal Packaging Europe explains that "recycling one tonne of metal scrap uses between 70-95 percent less energy than making one tonne of metal from virgin raw material" (Croasdell et al. 2015). Stimulating further improvements in metal recycling can positively affect competitiveness of Finnish packaging industry,



by making it less dependent on the imports from other countries. It can also positively affect the job market and create additional work places in the country. However, the most important benefit of the metal recycling is that it ensures that materials are not wasted in the landfill.

In Finland metal recycling is overseen by the previously mentioned organization Mepak-Kierrätys, which was founded in 1997 by the metal packaging manufacturers, packaging industry and retail-wholesale trade organizations. Mepak coordinates collection and recycling of the metal packaging waste in Finland. It also works towards reaching the targets, which have been set up by the most recent EU packaging directive.

With the introduction of the producer responsibility directive, which is a part of the Finnish Waste Act 2011, and some of the responsibilities going away from municipalities, Mepak has actually gained wider financial and operational responsibilities. It is planned that by 2016 consumer packaging waste collection points for metal will be expanded from the existing 130 to 1,850 points. Mepak will have a better control of the costs and performance levels. The organization will directly coordinate collection points and deliver information to consumers.

Metal is widely used for paint packaging. As an example, a Finnish paint manufacturer Tikkurila packages around 2/3 of its paint products in metal cans (Kivilä 2015, pers. com., February 2).

During the interview Tapani Sievänen shared his understanding that the individual motivation to recycle metal packaging is based on 3 key factors (Sievänen 2015, pers. com., January 12):

1. Effective education campaigns especially among young people
2. Elevating costs of mixed waste disposal for individuals and small companies, as opposed to recycling
3. Development of fully recyclable packaging (eco-design) as opposed to the packaging containing multiple materials, which require separation

Consistent and clear user communication that effectively reaches and resonates with the end user is necessary for achieving higher recycling rates of metal packaging. Easily understood guidelines for DIY customers and professional painters would help to keep metal away from landfills. Well-designed collection points will ensure that to return packaging is easy and simple.

One of the examples of a communication campaign, which has been implemented by the Metal Packaging Manufacturers Association (MPMA) in the UK, is a recycling label 'Widely Recycled at Local Council Recycling Centres' (Fig. 23). The label was located on metal paint cans to deliver the message straight to the consumers. In addition, leaflets highlighting local recycling points and paint disposal methods, including ways to dry out leftover latex paint,

were distributed through selected stores, recycling centers and local authorities (Messenger 2013).

Figure 23.
On-Pack
Recycling
Label
(Source:
Metal
Packaging
Europe
2013).



As part of its communication campaign Mepak intends to introduce "Metal recycles forever" label for the metal packaging in Finland (Sievänen 2015, pers. com., January 12). Licensed by the Metal Packaging Europe, the label is offered as "part of a behavioral change campaign (Fig. 24). Its goal is to inform consumers about the inherent recyclability of metal packaging and to encourage them recycle more" (Metal Packaging Europe 2015).

In addition to customer communication campaigns, appropriately located recycling points would most likely contribute to higher recycling rates. Mepak has evaluated that some municipalities in Finland have collection points located in the low-traffic zones, such as parks. Mepak is making an effort to relocate those collection points to retail outlets and petrol stations, where people circulate more often. Specifically for retail, Mepak has planned to locate from 300 to 350 collection points (Sievänen 2015, pers. com., January 12).

Figure 24. Metal
Recycles
Forever Mark
(Source:
Metal
Packaging
Europe
2015).



Design of the collection containers is equally important. Ability to deposit a wide range of packaging containers would contribute to a positive recycling user experience. According to the statistics of Värteollisuus, 1 l metal paint containers represent 42 percent (of the number of packages) of all the consumer metal paint packaging placed on the Finnish market. Larger containers, such as 3 l and 10 l paint cans, represent 32 percent and 20 percent of the consumer market volume respectively (Sievänen 2015, pers. com., January 13). Considering this

data, it is essential to provide collection points for metal with such containers that would make it possible for paint containers as small as 3 l and as big as 10 l to be deposited. If the opening for the recycling bins does not let users deposit larger 10 l containers, it might lead to the situation when the users simply leave those next to the collection bins. At the end, it will result in higher collection fees, elevated cleaning and transportation costs.

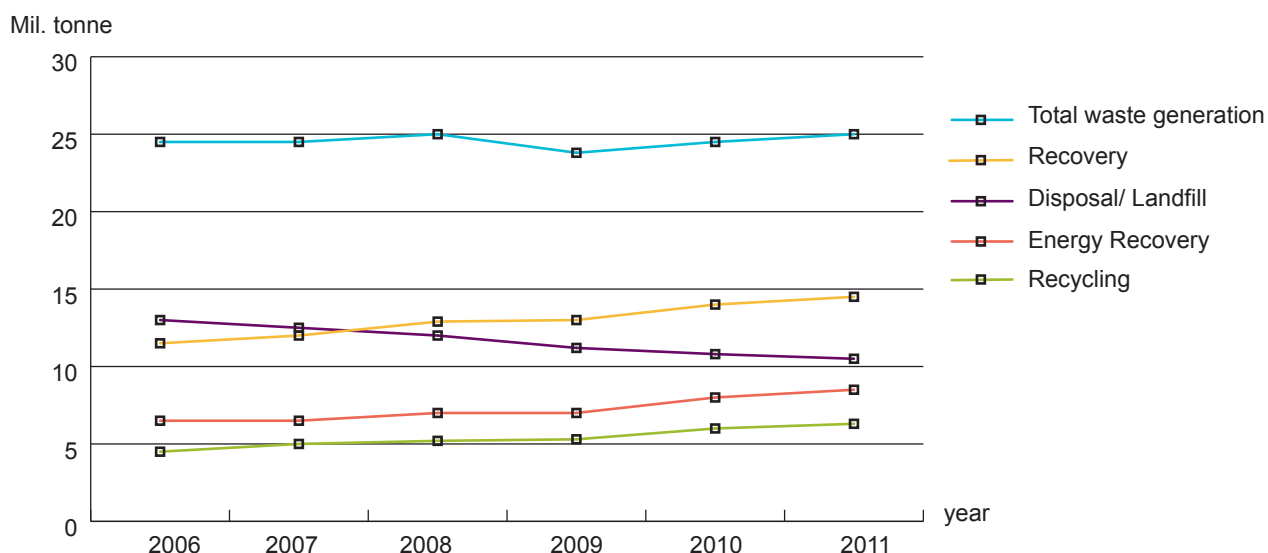
To summarize factors, which affect metal paint can recycling in Finland, it is important to name the following:

1. Consistent and clear user guidelines (deposit instructions, recycling labels)

2. Appropriately located collection points in high-traffic areas (retail, petrol stations, etc.)
3. User-friendly design of the collection bins, which allow deposit of a wide range of metal containers.

5.2 Plastic packaging

Plastics Europe (2012), Association of Plastics Manufacturers, reports that post-consumer plastic waste has increased by 2.4 percent in 2011 when compared with 2010 levels. Out of 25.1 million tonnes of post-consumer plastic waste collected in the EU, 10.3 million tonnes were landfilled and 14.9 million tonnes were recovered. Increased collection rates (5.7 percent for recycling and 4.2 percent for energy recovery) were primarily due to the increased use of plastic packaging (Fig. 25).



When talking about plastic packaging, it is important to mention why plastic is often chosen over metal despite a wider network of established infrastructure for metal recycling. According to the information published on the official website of a Finnish plastics recycling organization, plastic contributes to lightening of the package due to the reduced fuel consumption during transportation and other natural resource use, such as clean water. Most of the plastic can be reused, recycled or recovered for energy content (Suomen Uusiomuovi Oy 2015).

There is number of reasons as well why plastic paint cans are preferred over metal containers. First of all, plastic paint packaging is often preferred by the manufacturers, because it is less expensive. Second, plastic paint cans are

Figure 25. Total plastic waste recycling and recovery 2006 - 2011 (Consulting cited in Plastics Europe 2011).

lightweight therefore preferred by the users over heavy metal cans. The light weight also results in lower fossil fuel consumption during its transportation. Third, plastic cans often have a better closure system, due to an airtight seal that lets container to be opened and closed multiple times without compromising long-term paint quality. And finally, plastic containers eliminate the issues of rust and potential bacterial contamination.

According to Peter Rasmussen, managing director of Suomen Uusiomuovi, The Finnish Plastics Recycling organization, post-consumer plastics in Finland are not currently recycled, except for PET bottles and polyethylene packaging (Rasmussen 2014, pers. com., November 28). The majority of plastic waste is sent for energy recovery.

In 2011 report Plastics Europe stated that in order to capture the full value from plastics waste, different waste management options, such as recycling and energy recovery, need to be combined, avoiding landfilling plastics waste completely (PlasticsEurope 2011). Statistics presented in the report show that in the majority of EU countries recycling performance ranges between 15 and 30 percent, while energy recovery levels vary between 0 and 75 percent. Finland is one of those countries, which have improved its waste energy recovery rate by 30 percent, while its recycling rates have stayed persistently on the same level for a number of years.

In Finland recycling of plastic packaging is overseen by the plastic packaging producer organization Suomen Uusiomuovi. It is responsible for providing information and giving advice about recycling to its shareholders, businesses and individual consumers. Suomen Uusiomuovi has been working in close cooperation with PYR, Environmental Register of Packaging in Finland, to support post-consumer plastic packaging recycling.

As mentioned earlier, in Finland plastic recycling has been limited to trade and industry. According to a development manager of recyclable materials in Ekokem, an environmental and waste management service company, the main reasons for a low level of plastic recycling are: small volumes of waste, low value of recycled materials and high costs of recycling (Wiik 2014, pers. comm., December 11).

At the moment there is no adequately sized sorting and recycling facility for post-consumer plastic packaging in Finland. Ekokem has plans to build the first Eco Refinery, where recyclable materials will be separated from domestic household waste before it is sent for energy recovery. The facility will be built in Riihimäki by the end of 2015. It is estimated that 50 percent of the plastic waste will be recovered and recycled as material (Salonen 2014, Ekokem 2015). European Union has been gradually setting higher recycling targets for its member states. Timo Piekkari, Ekokem's CEO, believes that "meeting these targets will be impossible based on Finland's current investments in waste management" and Riihimäki plant is an essential benchmark for the country to improve its recycling

performance.

In addition to infrastructure shortage, Finland has a shortage of statistics on plastic collection volumes and recycling rates by plastic type. The situation is even vaguer with the volumes of plastic containers for hazardous products, such as paint.

According to the statistics from a Finnish paint manufacturer Tikkurila, around 1/3 of their paint is packaged in plastic cans. The company has been expanding the amount of paint products packaged in plastic containers, especially for DIY users in Finland. This decision will certainly affect the amount of post-consumer plastic packaging generated in Finland, and requires attention from producer organizations, waste management companies and municipalities.

One of the most unclear questions at the moment is how much leftover dry paint inside plastic packaging is acceptable for it to be recycled. The development manager of recyclable materials at Ekokem, believes that for recycling purposes paint is not an easy subject, as it will always stick to the material, even if cleaned with water. Plastic waste that contains paint can potentially risk the quality of a final material (Wiik 2014, pers. comm., December 11). During an interview a separate collection of plastic paint containers at retail and municipal collection points was suggested as a possible solution to the problem.

However, even if plastic paint containers are collected separately from the rest of post-consumer plastic packaging, it will still not solve the problem of plastic contamination. Innovated packaging ideas need to come either from paint manufactures or from waste management industry as a technological solution.

In 1995 first Nordic recycling centre for paint cans and oil filters opened in Halmstad, Sweden (Stena 2014). A treatment plant is using cryogenic technology developed in the Netherlands. By undergoing treatment with liquid nitrogen, paint and varnish residues are mechanically separated from the packaging. Further separation divides metal from non-ferrous materials, such as plastic.

With packaging recycling indicated as an urgent priority in Finland, a cryogenic recycling facility could potentially solve a problem of paint plastic can recycling in Finland.

To summarize the situation with plastic can recycling in Finland, it is important to name a few of the existing obstacles:

1. Danger of plastic waste stream contamination by leftover paint
2. No established processes that allow effectively and economically separate liquid and dry paint from plastic paint packaging
3. Absence of the recycling statistics for post-consumer plastic packaging.



REUSING PAINT IN THE COMMUNITY
Dulux, proud sponsor since 1993



Image source: logo paintcare.org, logo communityrepaint.org.uk, logo newlifepaints.com

BENCHMARKING

There are number of waste paint management programs, which operate in different parts of the world. Waste paint typically comes from either household consumer waste, retailer/distributor returns or from professionals, such as paint contractors and construction companies.

Paint re-manufacturing programs collect unwanted paint; transport it to the facility where it is sorted, filtered, blended, tested, packaged and transported to outlets for sale. Paint re-purposing programs collect unwanted paint, which is in good condition, pre-sort it and re-distribute to individuals or organizations, which are in need of paint.

Looking at examples from around the world, we can see that in the US and Canada paint industry has been actively cooperating with the government. Paint stewardship has been used as a responsible way of managing waste paint. It has proven to be less costly and more flexible than other available methods of managing paint waste (GlobalPSC 2013).

Here are some of the examples from abroad, demonstrating different approaches in paint waste management:

- In the US the situation with paint recycling has been steadily improving, as American Coatings Association has been active in getting the state governments to promote and take action towards paint recycling.
- Canada has shown so far the most success in paint recycling by adopting matured and advanced methods of dealing with leftover paint: "There is a significant partnership and commitment between paint manufacturers and local government to support paint recycling" (Bagaria 2012, p. 15).
- In Australia paint manufacturers have received approval from regulatory organizations to voluntarily add a recovery fee to fund a paint collection

program, but were met by a strong opposition from large retailers. Eventually the fee was indefinitely suspended (GlobalPSC 2013).

- In the UK waste management companies often pay to recyclers, such as Newlife Paints to collect waste paint from them for its recycling. By outsourcing waste paint, waste management companies save money on its treatment.

6.1 Costs and Financing

Responsibility programs for management of waste paint have different financing structures. They can be either industry-led or funded by the government. Additionally, a fee can be included into the product price and passed along to consumers. Typically, sustainable waste management programs utilize a combination of funding sources, which might be beneficial for its long-term agility.

A waste management fee, intended to support end-of-life paint management, can be paid as a nominal fee when paint is purchased at the store. According to Global Product Stewardship Council (GlobalPSC 2013, p. 5), the fee can be either incorporated into the price of a product, so that it does not appear separately from the product price on the receipt, or it can be passed as a visible fee to consumers.

6.2 Motivation and Stakeholder Engagement

Voluntary cooperation of the paint industry stakeholders towards a more sustainable paint management can act as a signal for those, who opt-out: if this approach is not enough to address the problem, legislation will “tighten up” in the future. However, if the cooperation produces positive results, early participants will be able to enjoy greater flexibility and commercial benefits.

For retailers participation in a voluntary collection scheme would bring commercial benefits, such as additional foot traffic into stores and potentially increasing sales. Resistance from retailers is stated as a primary limitation by the Global Product Stewardship Council (GlobalPSC 2013). They explain that retailers are often concerned about program fees being passed along to consumers, because they think that it might affect their competitiveness. Reporting, however, indicates that none of the existing international programs managing waste paint have indicated a decrease in sales caused by the introduction of a fee. On the contrary, several retailers have reported that paint collections have increased foot traffic and sales at their stores, even after program fees were introduced. (GlobalPSC 2013, p. 6).

Non-profit and community organizations can support responsible programs by providing necessary resources for sustainable management of waste paint. They can act as mediators of recycling activities.

Participation of DIY consumers and professional painters can be difficult to achieve. It depends on a variety of factors. A community involvement study analyzed a household hazardous waste recycling event in the town of Hammond, Louisiana (Massawe et al. 2014). Its participants named commitment of the city officials to recycling efforts to be one of the motivating factors for their participation. Among the weaknesses they named a short duration of the event and lack of the public transportation to the event. Availability of both permanent and temporary collection facilities might help to solve the problems of transportation to the point of waste delivery and shortage of time.

Raising awareness and supporting educational efforts is a necessary component to initiating a successful sustainable paint waste management program. Equally important is engagement of all the stakeholders in the design and implementation of the program. The main purpose of such engagement is to bring together for a common discussion all the parties involved in management of paint and its packaging.

6.3 Paint Stewardship: Paint Care

In the USA leftover paint management has been addressed by product stewardship programs. According to Cassel (2008, p. 160), "product stewardship is an approach in which manufacturers, importers, retailers, government officials, consumers, and others share responsibility for reducing negative impacts to human health and the natural environment that results from the production, use, and end-of-life management of a product."

In the case of a product stewardship, all stakeholders, involved in the life cycle of a product unite efforts to address problems associated with the product. Each stakeholder has different responsibilities and a unique participation role in the program, which is defined by their ability to create the greatest impact over the product lifecycle. For example, manufacturers have the most significant knowledge of the product and can redesign the product and improve its environmental performance (Cassel 2008). Retailers have the strongest connection with the customers and can affect their purchasing decisions and the way they dispose of the paint waste and packaging.

According to Cassel (2008), product stewardship is an optimal system for spreading responsibilities between the parties to provide information, logistics, funding and the end of life product management. By shifting the costs and responsibilities from municipalities to private sector and consumers, the program supports efficient practices, supports change of behavior by capitalizing on

incentive systems and reduces overall system costs.

As already mentioned in previous chapters, there are several product stewardship programs for post-consumer paint around the world, each with a set of unique conditions and different stakeholders. One thing they have in common is that all of them represent an alternative way of the end-of-life management for paint products.

In the United States, PaintCare, a non-profit organization, plans and operates drop-off sites for unwanted paint (Fig. 26). It is active the most in those states that have passed paint stewardship laws. Originally created by the American Coatings Association, it started from a pilot program in 2009 and since then has spread to other states and has become permanent. From the very beginning, it was decided that all stakeholders should be part of a solution. Stakeholders included all the parties, who were interested in paint management: state and local governments, paint recyclers, waste transporters, environmental organizations, waste management companies, PSI (product stewardship institute), etc.



Figure 26. PaintCare website (Source:www.paintcare.com, 2015).

According to Marjaneh Zarrehparvar, executive director of PaintCare, "paint is the most common household hazardous waste in the US: the largest by volume and by cost" (Zarrehparvar 2015, pers.com., January 2). During the interview Zarrehparvar explained that prior to PaintCare, residents had options to dry out leftover latex paint or alternatively dispose of paint in either government-run household hazardous waste facilities or to drop it off during a mobile waste management event, which is typically organized once a year in certain locations. After introduction of PaintCare, new drop off locations, mostly at retail outlets, were arranged. A wider network of collection points and their accessibility during longer business hours have made paint disposal more convenient for the public. (Zarrehparvar 2015, pers. com., January 2).

At the moment both paint manufacturing industry and paint retailers fully support the program. At the beginning, however, according to PaintCare executive director, retailers were skeptical about the fee added to the paint price to compensate stewardship program expenses. Because paint industry wanted that everybody would have an equal position on the market, they insisted that the fee would be passed down to consumers. Retailers were concerned that if their prices would go up, it could affect their competitiveness and people would be buying less paint from their store. Larger stores, such as Walmart and Lowe's, were against the program, because they feared that if they agree to accept unwanted paint returns, later they would be required to take back other products that they sell. After all, big retail shops did not want that a quarter of a store would become a take-back location. Over the time, though, retailers noticed the benefits, such as an increased foot traffic and community support. These observations affected their perception of the program, and ultimately, it has gained a big support from their side. Another group that originally opposed the program was painting contractors. Knowing that the added fee for paint had to be included in the contracts, paint contractors and construction companies were informed early enough about the introduction of the fees. By doing that, the resistance to change from professional painters was avoided. Moreover, an opportunity to deliver leftover paint, after a painting job has been completed, was highly appreciated by the professional users.

According to Marjaneh Zarrehparvar (2015, pers. com., January 2), in those states, where PaintCare takes back latex paint, it is turned into paint with recycled content. Paint stewardship legislation advocates that paint would be managed in the 'highest' responsible way possible, following the waste management hierarchy. The goal is to educate public to buy the right amount of paint and reduce the amount of waste. Next step is to donate paint, which is still in the package and is in good condition. And the last, is to recycle leftover paint. PaintCare model supports the above mentioned efforts: "Buy right, use it up, recycle the rest" (Zarrehparvar 2015, pers. com., January 2). According to the executive of PaintCare (2015, pers. com., January 2), 70 percent of all the returned paint is latex, which in most of the cases is recycled into new paint. The

rest of it is oil-based paint, which is mostly sent for energy recovery.

PaintCare does not take responsibility for the paint containers. Environmental community, however, believes that paint and paint packaging come together and are pretty much inseparable. Most of the metal paint containers get recycled. Waste management of plastic packaging differs from state to state, depending on the local waste management infrastructure.

6.4 Paint Re-manufacturing: Newlife Paints



Figure 27.
Eco-paint
from Newlife
Paints
Source: www.newlifepaints.com, 2015).

On the other side of the Atlantic Ocean in the UK a lot of attention has been paid to moving the country towards a circular economy. According to Keith Harrison, managing director of Newlife Paints, “the government has been active in the area of re-manufacturing, where you are taking old and unused materials and re-manufacturing them into new ones” (Harrison 2014, pers. com, December 22). In the public eyes, circular economy efforts look worthy. The gap between what people say and what their actual actions are, is the reason why companies like Newlife Paints are in the marginal area of paint market.

One of the solutions to this can be raising a public profile for paint recyclers. Newlife Paints is trying to promote specification of recycled materials, including paint, when the government departments purchase materials. For example, in order to lower carbon footprint, 10 percent of paint needs would be required to come from a recycled paint manufacturer. The goal behind it is to make re-manufactured paint to be a well-known product, used by both private and public sector. Keith Harrison believes that if people start using products with recycled content more often, later they won’t even think about it. Eventually it will become normal to use recycled materials, which will open up the markets for these kind of products.

In addition to a limited consumer interest, Newlife Paints faces criticism from the supporters of waste incineration. Answering to the question of what is more efficient, paint waste incineration or its recycling, Keith Harrison talks about energy content and the cost of collection. First of all, as opposed to the solvent-based paints, there is little combustible material in water-based (latex) paints. Water-based paint contains mainly water and minerals, and it takes energy

and higher amount of fuel to heat it up. Second, it might cost more for waste management companies to collect paint separately from other hazardous waste materials in order to recycle it. It is, of course, not the same in case of incineration, because all the waste mass is incinerated together. However, this argument ignores the loss of such materials, like resins, binders, and titanium dioxide, with the latter being neither cheap nor abundant. Recovered waste paint is a material that has value and can make a profit. Managing director of Newlife Paints, Keith Harrison, said: "Waste paint has a surprising intrinsic value, so that it can be re-manufactured competitively" (Benoy et al. 2014, p. 63).

In the UK Newlife Paints receives 90% of its water-based waste paint directly from the local waste management companies. In fact, waste management companies pay for the paint waste to be taken away. The rest 10 percent of the suppliers include construction companies, which prefer to deliver paint directly to Newlife Paints for the cost reasons. During a pre-sortment solvents are returned back to the waste management companies. What is left is evaluated based on its quality, leaving roughly 50 percent of good quality paint. Then paint is separated by color, tint and finish (matt from gloss) (Fig. 28).

Newlife Paints not only re-manufactures paint in the UK (Fig. 27), it also sells licenses to other companies. Some clients are relatively small, re-manufacturing paint in small quantities on the local level, while others are large multi-national

Professionally Reprocessed, Recycled Paint - Here's The Science...



Figure 28. Science behind the reprocessed, recycled paint by Newlife Paints (Source: www.newlifepaints.com, 2015).

companies. Veolia, a multi-national French-based waste management company, has been one of the clients, who want to establish a well-functioning paint recycling and sell re-manufactured paint through their own outlets.

In addition to licensing, Newlife Paints is involved in research around paint re-manufacturing and packaging recycling. The company, together with its sponsors Akzo Nobel and King Fisher group, is investigating possibilities for recycling plastic packaging. The main questions that still need to be answered are:

- acceptable level of contamination for plastic recovery
- method of a possible paint container cleaning
- financial viability of the paint packaging recycling processes

In the research, Newlife Paints has been looking at several possibilities for cleaning used plastic containers:

- washing cans
- freezing the leftover contents
- using vibration mechanism to separate paint from the containers

Washing cans has shown to be unsustainable as it produced large amounts of waste water, raising energy demands and increasing costs of waste management. Other methods are still in the testing phase. As an alternative to paint removal, the company has been also looking at adding a repellent layer to the packaging to prevent paint from sticking to the container.

Some of the obstacles mentioned by Keith Harrison, that Newlife Paints has been facing are:

- Balancing supply and demand: getting enough paint waste stock, but not too much that it would exceed the allowed amount of stored waste material
- Complying with REACH directive: paint re-manufacturing requires pre-screening of stock for low-VOC content, which ensures that final product does not have high VOC levels. VOC testing of each paint batch is not commercially viable and puts paint recyclers in an unfair competition with the manufacturers of virgin paint
- Following labeling requirements, regulations and product standards, which differ from country to country.

6.5 Paint Re-use Programs

Community RePaint

In the UK, as stated by the European Commission (Gendebien et al. 2002), over 300 million liters of paint is sold annually to the individual and to professional customers. It is estimated that 37.5 million liters from the DIY paint and 2.5 million liters from professional paint remain unused. In fact, paint is typically stored and later disposed to landfill. Even though, following the Landfill Directive, the disposal of liquid paint is illegal in the UK; according to Keith Harrison, waste management companies often avoid the regulation and claim to be 'solidifying' paint prior to disposing it in the landfill. They claim doing so by mixing it with other solid waste (Harrison 2014, pers. com., December 22). The disposal of mixed liquid paint with the solid waste leads to leachate of dangerous substances at landfill sites, release of solvents into the air, pollution of water sources and contamination of soil.

As opposed to the disposal of leftover paint at landfill sites, its collection and re-use is highly desirable. In the UK, a paint re-use initiative called Community RePaint was launched in 1994 (Fig. 29). The purpose of the scheme is to divert the paint from the main waste stream, collect and re-distribute it (by means of self pick-up). The issues around paint, which are mentioned on the Community RePaint official website (2015), include "the environmental cost of paint ending up in the natural environment, the economic cost of incineration of waste paint and the social cost." Collected reusable paint is donated to individuals, families, and various community, volunteer and charity organizations (Gendebien et al. 2002).

According to the official website of the initiative, donated paint helps to improve the well-being of people and the appearance of places across the UK (Community RePaint 2015). The initiative also generates voluntary work and supports charities.

The initiative works as a national network of schemes, operated by local

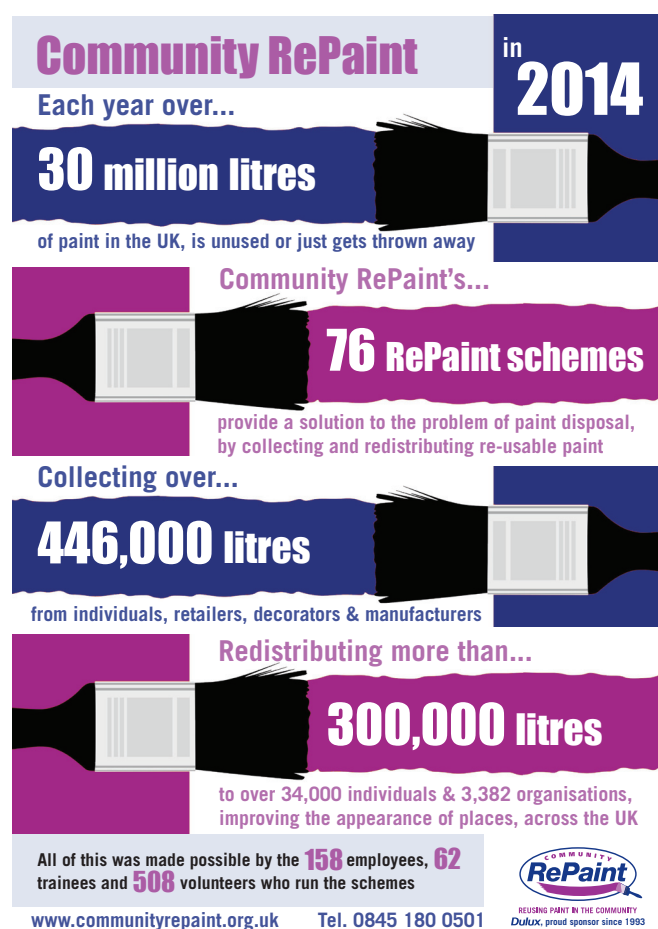


Figure 29. 2014 statistics, Community Re-Paint network (Source: Community RePaint 2014).

community organizations in England, Northern Ireland, Scotland and Wales. Only paint in original containers with remaining labels, which has not been mixed with other substances, is accepted. After it has been sorted, it is stored for a pick up by a recipient group.

According to the official statistics by Community RePaint (2015), which is published on its website, in 2013 the network saved over 410,000 liters of paint and re-distributed over 245,000 liters to community, charity and volunteer organizations. In 2014 the amount of collected paint increased to 446,000 liters, out of which more than 300,000 liters were redistributed to over 34,000 individuals and 3,382 organizations.

In 2002 report published by the European Commission (Gendebien et al. 2002), among limitations and obstacles of the network it lists a problem of finding a consistent supply, which would match the demand and variations of quality based on the method of paint collection (typically good quality from household waste recycling centers, and excellent – from retailers and other drop-off sites). It also mentions that the network retrieves less than 1% of the leftover paint, and suggests that increasing the coverage area might improve collection rates.

Sustainable Beauty

In Finland, the paint manufacturer Tikkurila Oyj has a program for social responsibility, called “Sustainable Beauty.” The aim of the program is to inspire people and communities towards improving their living environment and creating beautiful and unique spaces. The company takes applications from projects that focus on enhancing well-being, creating joy, comfort and sustainable environment.

Projects have been taking part not only in Finland, but also in Serbia, Belarus, Russia, Lithuania, Latvia, Estonia, Poland, Germany and China. Overall, since 2012 Tikkurila has been supporting 60 Sustainable Beauty projects in more than ten countries (Kivilä 2014).



Figure 30. Martinlaakso mural, Vantaa (Source: Tikkurila Group 2015).

Selected projects have to fulfill criteria and be motivated by an effort to improve well-being and beautify public environment. Some of the completed in the past projects included day cares, schools, children's hospitals, and urban spaces, such as parks and underpasses.

In Finland in 2014 Tikkurila donated paint for 10 projects, among which there are Kalasatama park in Helsinki, Rajakylä day care center in Vantaa and Mural project in the old candy factory in Turku. One of the most vivid and recent projects that received paint is Street Art Vantaa (Fig. 30). Street art projects, which became possible because of the paint material support, transformed dull and uninviting underpasses in the city of Vantaa into colorful and appealing pathways. Paint was applied using a street art technique, instead of a traditional graffiti.



Image source: Street Art Vantaa, Tikkurila Oyj, tikkurilagroup.com

CASE STUDY

7.1 Paint Manufacturer: Tikkurila

Tikkurila is a company producing a wide variety of paint and varnishing products for protecting and beautifying surfaces. It was founded in Finland 150 years ago, and it has been an influential regional player in Nordic and Eastern European countries. In Finland Tikkurila is one of the leading manufacturers of decorative paints, with a market share of over 50 percent.

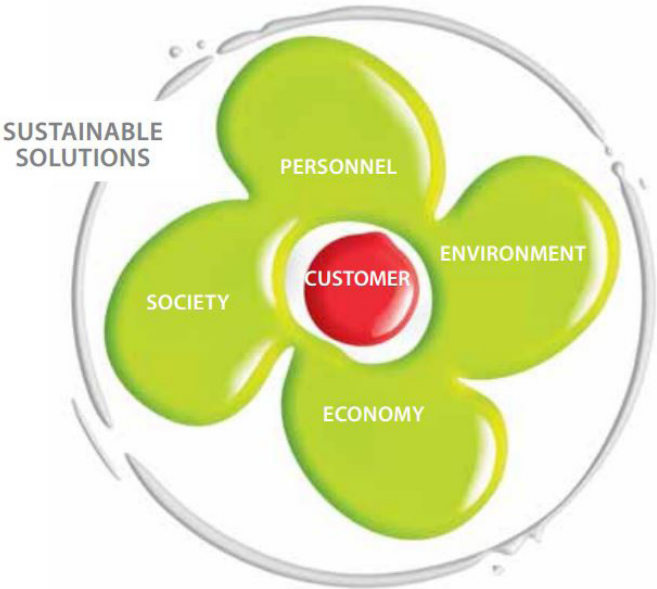
The company has been focusing on decorative paints, which in 2012 accounted for 84 percent of its total revenue (Tikkurila Group 2012). In the recent years the share of water-borne paint products has been growing. According to Päivi Kivilä (2015), Tikkurila Corporate Responsibility manager, 72 percent of the products manufactured by Tikkurila in 2014 were water-borne.

Tikkurila's customer group for decorative paints is divided into individual consumers (DIY customers) and professionals (contractors, designers, house managers, construction companies and developers). With the products for renovation and repair, the company reduces its sensitivity to economic fluctuations, and it can offer a steady supply of paint products to the market. Tikkurila sells decorative paints in home improvement stores, paint store chains and independent paint retail outlets. Tikkurila's competitors in Finland include: Teknos, AkzoNobel, NorMaali, Sherwin-Williams and several local producers, such as Uula and Escaro.

7.2 Corporate Responsibility

The company has been reporting about its commitment to sustainability and progress in the user interaction for a number of years. The development in sustainability is tracked on a regular basis. Already in 1970s Tikkurila started

to make efforts to protect the environment by reducing its solvent emissions in production of paints (Manninen 2012, p. 266). Since 2010 Tikkurila has been reporting on its progress according to GRI guidelines. Tikkurila’s environmental policy follows its corporate responsibility program (Fig. 31).



Its responsibility and sustainable development goals are based on the information gathered from the internal surveys and other work with stakeholders. For its 2014 reporting the company used personnel and customer satisfaction surveys from the countries, where it has the highest paint sales.

In 2014 three main priority areas were defined: user experience, resources and people (Kivilä 2014) (Fig. 32).

In the user experience priority area the company focuses on

Figure 31. Tikkurila’s Sustainable Solutions (Source: Tikkurila 2009).



Figure 32. Tikkurila’s CSR Priority Areas 2014 (Source: Tikkurila 2014).

customer and supplier cooperation and development of new user-friendly and functional solutions. In the resource area Tikkurila sets the goal in improving material sourcing and lifecycle thinking in product and service development. Focus on well-being, occupational health and safety are part of the people priority.

In its corporate responsibility reporting (Kivilä 2014) Tikkurila recognizes environmental impact of paints, and advocates for looking at the paint throughout the entire product life cycle: from material sourcing to waste management. The quality of the product is considered to be an important factor, which affects sustainability of the paint: the better the quality, the longer maintenance intervals and the smaller 'touch-up' requirements are.

7.3 Recycling and Waste Management

In its Corporate Responsibility report Tikkurila says that "responsible painting includes appropriate disposal of waste" (Kivilä 2014). Tikkurila sees that better paint disposal and recycling of packaging is part of its work in minimizing environmental impact of its products and promoting sustainability in painting (Kivilä 2014).

The screenshot shows the Tikkurila website's paint calculator tool. The header features the Tikkurila logo and navigation links: KOTIMAALARIT, AMMATTILAISET, TEOLLINEN MAALAUS, and KAUPPIAAT. A search bar is located on the right. Below the header, a secondary navigation bar includes links for VÄRIT, IDEAT, TUOTTEET, OHJEET, OSTOPAIKAT, and TEKIJÄT. The main content area is titled 'Maalilaskuri' (Paint calculator) and includes a sidebar with various painting-related links. The calculator itself prompts the user to enter the height and width of the surface to be painted, as well as the paint's coverage rate. It then calculates the total paint required in liters.

| Field | Value | Unit |
|--|-------|-------------------|
| Korkeus (Height) | 0.00 | m |
| Leveys (Width) | 0.00 | m |
| Maalattavan pinnan... (Painted surface area) | 0.00 | m ² /l |
| Pinta käsitellään... (Surface treatment) | 1 | kertaa (times) |
| Maalia kuluu (Paint consumption) | 0 | litraa (liters) |

Figure 33. Maalilaskuri, Paint calculator, available in Finland (Source: Tikkurila 2015).

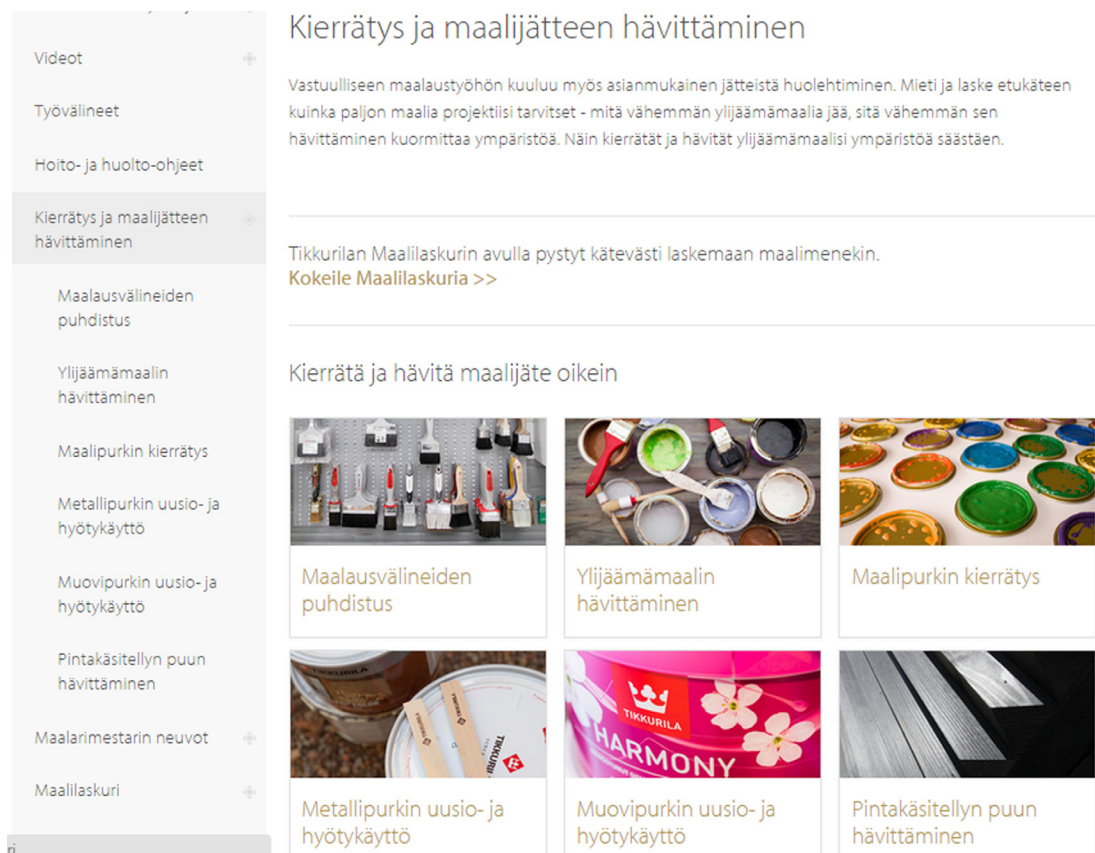


Figure 34. Recycling and paint waste disposal, *Kierrätys ja maalijätteen hävittäminen* (Source: Tikkurila 2015).

As part of the sustainability agenda, Tikkurila has been participating in the Responsible Care program in Finland, which is supervised by the International Council of Chemical Associations. Paint waste originates not only during the production, but also during the use phase, when paint is applied to the surfaces. On the company's website in Finland customers can find a paint calculator (Maalilaskuri), which helps them to decide how much paint exactly they need for a project in order to avoid unnecessary waste (Fig. 33).

Customers can find on the company's website instructions on how to properly dispose of the leftover paint and packaging (Fig. 34).

Starting from 2000, Tikkurila's advisory services were complimented by adding a Paint Hotline, which assisted both DIY and professional consumers (Fig. 35). It is possible to also get advice online and by e-mail.

The company also includes the topic of recycling into its trainings and campaigns. The most recent campaign for the exterior painting, Maalaustalkoot, includes the topic of the disposal of leftover paint (Fig. 36).



Figure 35. Maalilinja, Phone customer service for painting (Source: Tikkurila 2015).

Development of additional services, which not only provide advice, but also make sustainable disposal of paint easy, would bring further progress. Findings from the Focus Groups, which were organized in Finland, Sweden, Russia and Poland (Makki 2014, pers. com., August 4), show that Finnish customers see leftover paint service as a great way to solve the problem of waste (Fig. 37).

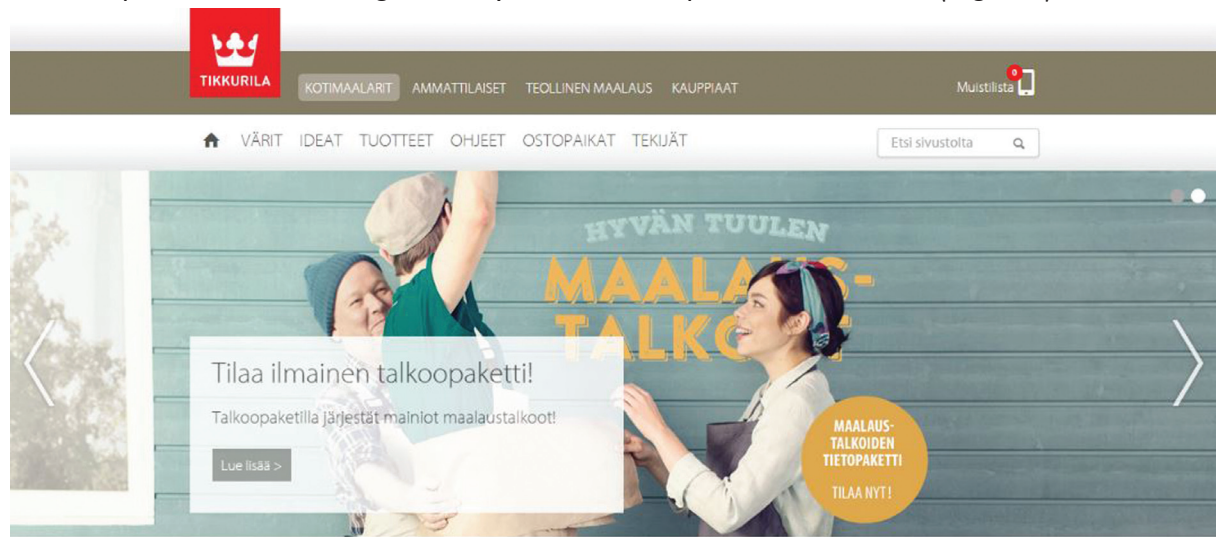
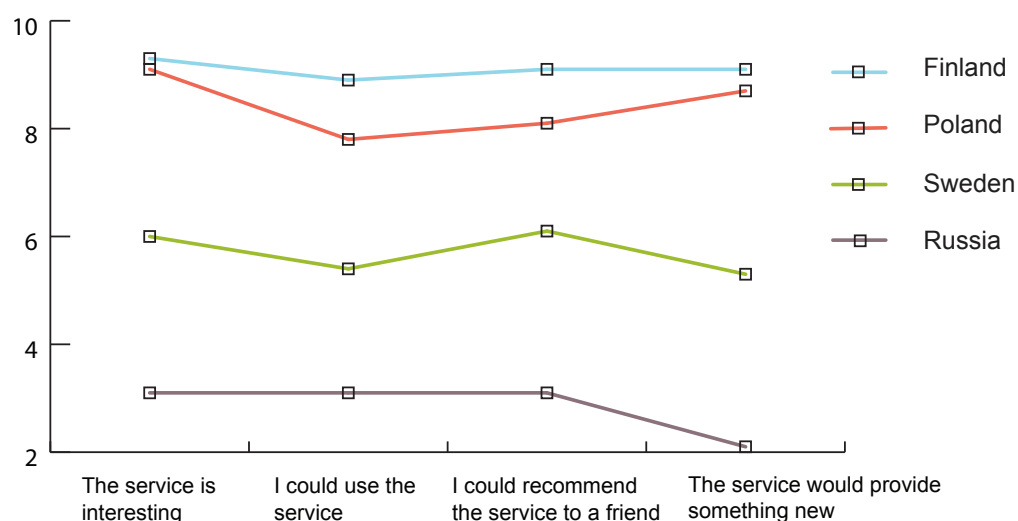


Figure 36. Maalaustalkoot (Source: Tikkurila 2015).

Figure 37.
Findings
from the
focus groups:
leftover
paint service
(Source: Makki
2014).



According to the majority of answers, the service would need to work very easily, without creating any extra effort. Some of the obstacles, which were mentioned by respondents, included: expiration and drying of paint over time, possible contamination of paint containers and legal responsibilities in case of safety problems.

To support its sustainability work further, Tikkurila launched a waste management research project in 2014. The goal of the project was to explore opportunities for a more efficient waste paint management. In the next chapter findings from the research project are described in more detail.



Effective sustainable design is possible when sustainable methodologies are combined with user experience studies.

Image source: [freeimages.com](https://www.freeimages.com), content license

RESEARCH METHODS

This graduate research used a variety of methods, such as:

- literature analysis
- legislation research
- SLCA
- benchmarking studies (Chapter 6)
- customer journey mapping
- case study (Chapter 7)
- interviews
- surveys

In this chapter practical research methods and data collection processes are described in detail.

8.1 SLCA

In 2014 sustainability targets and actions of Tikkurila, the company from the case study, were assessed by the Natural Interest consultancy, through life cycle analysis and user studies. Research work started from SLCA (Sustainability Life Cycle Assessment), which focused on the use and the end-of-life phases. Natural Interest uses SLCA as an assessment tool that helps to receive a strategic overview of social and ecological sustainability (The Natural Step 2015). The tool helps to make a quick, but scientifically rigorous assessment, covering the entire product

life cycle and sustainability problems. As opposed to a traditional Life Cycle Analysis, which is based on data-intensive calculations, SLCA shows results in a color coded matrix. The matrix gives an overview of the impacts through the life cycle, pointing out the “hot spots,” where attention is needed the most.

SLCA is based on Natural Interest Framework for Strategic Development and should not be confused with Social Life Cycle Analysis. The latter complements traditional Life Cycle Assessment by assessing and reporting about the impacts of products and services in terms of social and socio-economic impacts on workers, local communities, consumers, society and all value chain actors (UNEP 2009).

Natural Interest SLCA’s questions relate each life cycle stage of a product to the four sustainability principles, which describe conditions of a completely sustainable system. Four sustainability principles were mentioned earlier in this research introduction, and are also described in the image below (Fig. 38).

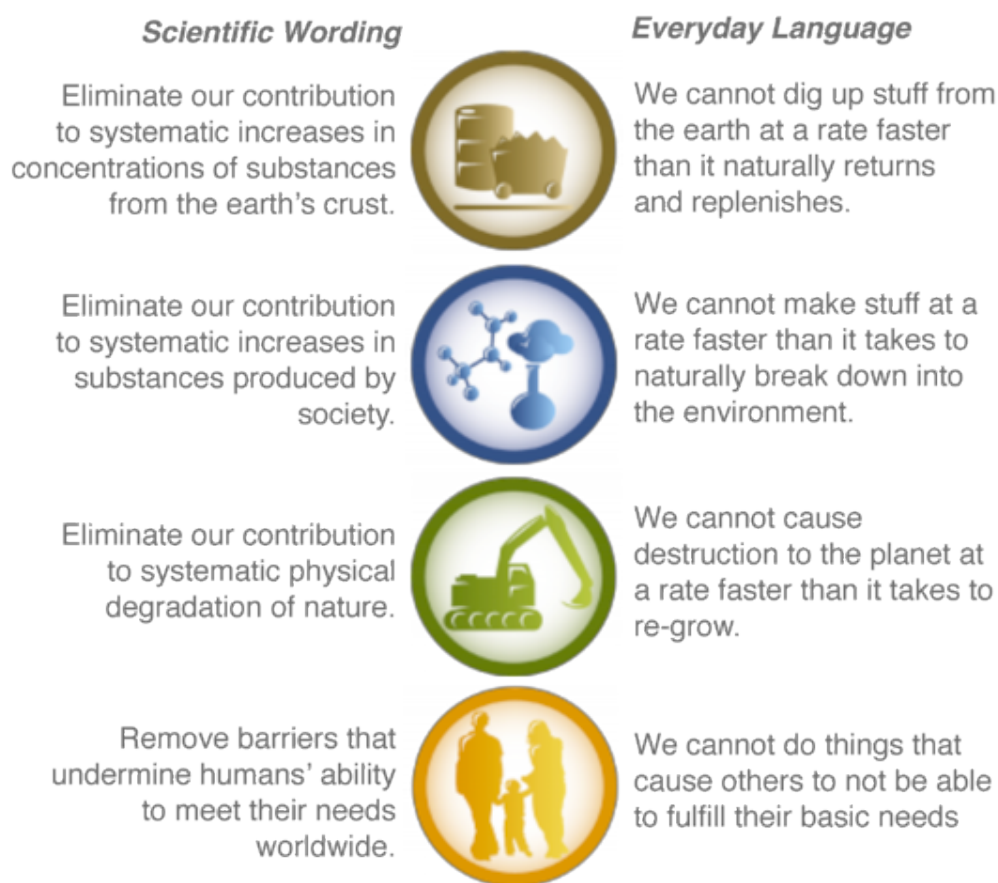


Figure 38. Four sustainability principles (Source: The Natural Step 2015).

In SLCA there are 140 questions that need to be answered (7 questions in relation to each sustainability principle for each of the five product life stages)





| LIFE CYCLE STAGES | | RAW MATERIALS | PRODUCTION | PACKAGING & DISTRIBUTION | USE | END OF LIFE |
|---|--|---|------------|--------------------------|-----|-------------|
|  | Sustainability Principle 1 Does the product life cycle contribute to the build-up of substances from the earth's crust? (metals, minerals, fossil fuels, etc.) | Carefully directed questions are asked for each life cycle stage and sustainability principle. | | | | |
|  | Sustainability Principle 2 Does the product life cycle contribute to the accumulation of substances produced by society? (persistent chemicals, etc.) | | | | | |
|  | Sustainability Principle 3 Does the product life cycle contribute to physical degradation of nature? (overfishing, land destruction, erosion, etc.) | The answers to the questions are analyzed to identify key impact areas. Color codes are assigned accordingly. | | | | |
|  | Sustainability Principle 4 Does the product life cycle contribute to any conditions that undermine people's capacity to meet their needs? (unsafe working conditions, health issues, etc.) | | | | | |

Figure 39. Structure of questions for assessing current product sustainability during SLCA process (Source: Redrawn from The Natural Step 2015).

(Fig. 39). These questions are split into impact questions and progress questions. Matrix, which is created at the end of the assessment, is color coded; and with the cells, numbered according to how many questions were answered positively. Red color indicated the highest number of “no” answers, while green – the highest number of “yes” answers. Differences between the numbers were influenced also by “not applicable” answers, if the questions were not relevant for the assessment.

8.2 Customer journey map

Effective sustainable design is possible when sustainable methodologies are combined with user experience studies. As part of the user experience research, this study looked at how customer engagement with sustainable painting can be improved. A ‘secret’ store visit and a discussion with personnel about sustainability and paint, helped to illustrate possible obstacles that users might have. On a customer journey map life cycle stages of paint were aligned with the “tools” that helped to reach optimal shopping results (Fig. 40). The “tools” included:

- Personal advice

- Website
- Phone application
- Marketing material
- Retail
- Help line

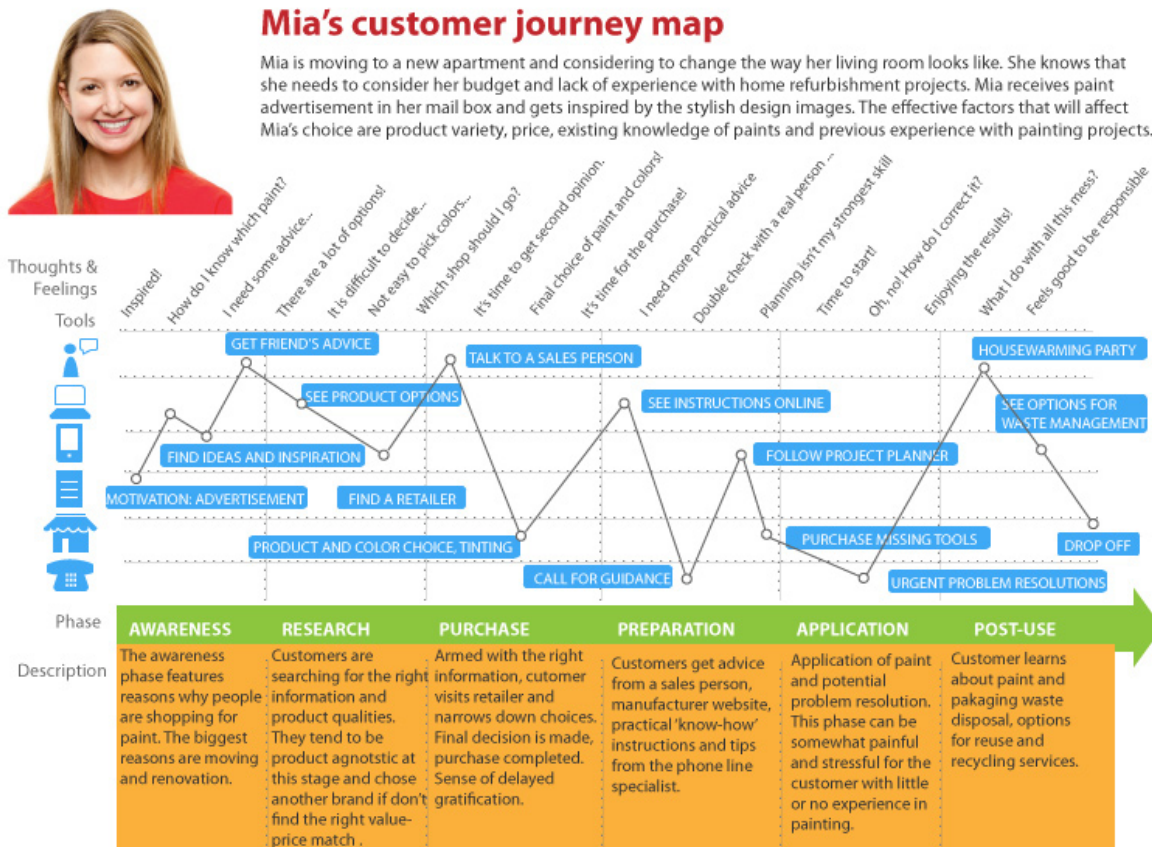


Figure 40. Customer sustainability journey (Source: Natural Interest 2014).

Customer decision touch points helped to see what problems the user might be experiencing during each stage of the journey and what kind of emotional responses they might have.

8.3 Internal surveys

The research also included internal online questionnaires that were sent to 200 Tikurila's employees. Out of them, 150 responses were received. In the survey responses employees commented that the internal communication about

sustainability decisions in Tikkurila had been weak and customer relations underutilized. The majority of the suggested actions were focused on improving dialogue with stakeholders, creating additional customer services and doing a more rigorous analysis of the customer feedback.

Based on the survey results, five internal profiles were delivered. Each profile included:

- Brief description of a typical employee
- Key words from the survey answers
- Quotes
- Relationship with sustainable products
- Customer relationships and sustainability trends

8.4 Interviews

In order to evaluate the system of waste management in Finland, data has been collected from a total of 24 interviews. The full list of interviews can be found in Appendix A at the end of this research.

Interviews with Company Personnel

In order to understand what company's personnel thinks about paint waste management situation, 6 interviews with the staff members were organized. The interview data helped to see how paint waste management could be developed alongside with sustainable user experience.

The key questions for interviewees included:

- What do Tikkurila's customers think about paint waste management? Do they express any concerns or ask for solutions?
- What are the biggest sources of paint waste among professionals and DIY customers? Do you see any opportunities to minimize those things?
- Could a take-back service for leftover paint bring additional value to customers?
- Do you see that deposit-return system for leftover paint and paint packaging would work in Finland?

- Do you know of any examples of paint waste being used in non-paint materials?
- How viable do you think paint reuse, recycling and re-manufacturing can be in Finland?

Interviews with External Experts

In order to evaluate how well paint waste management system is organized in Finland, data has been collected through a series of interviews with external experts. The interviewed organizations and persons included:

- Waste management companies (Ekokem, L&T and Stena)
- Architectural firm
- Painting consultant
- Financial analyst
- Producer responsibility organizations (Suomen Uusiomuovi and Mepak Kierrätys)
- Retail chains (K-rauta and Maalarimestarien)
- PYR (The Environmental Register of Packaging)
- JLY (Finnish Solid Waste Association)
- HSY (Helsinki Region Environmental Services Authority)
- Värteollisuus (Association of Finnish Paint Industry and Printing Ink)



Figure 41.
Key for the
stakeholder
map (p. 93)

Companies)

- City of Helsinki, Environment Centre

On the diagram (Fig.41, 42) it is possible to see the role of expert organizations in management of paint waste at the moment. Red dots mark so-called “missed opportunities,” where sustainable actions could improve the current state of waste management. Green dots identify positive actions that are already reinforcing sustainability.

Registration of chemicals with REACH has been mentioned in the interviews as one of the obstacles for developing recycling solutions for liquid paint waste. Another mentioned obstacle was the cost of material separation, which is necessary in order to avoid contamination of recycled packaging material. It is important to note that separate recycling of paint cans faces the problem of small material volumes.

When talking with experts about leftover paint packaging, metal was told to be well recycled in Finland. Plastic packaging, however, was named to be the biggest problem, because it needed to be cleaned before being sent for recycling. Paint is not an easy material for recycling, because it sticks to the packaging material.

8.5 Surveys

Surveys were designed with an objective to assess perceptions of individual customers and professional painters about management of leftover paint. The main goal was to understand what DIY and professional users usually did with leftover paint, what kind of obstacles they had and how their experience could be improved. Main questions that were asked in the survey are:

1. How much leftover paint do people actually store?
2. What do they do with their leftover paint?
3. Are people willing to do extra work to support recycling?
4. What is considered to be the most convenient way to dispose of leftover paint?

Two surveys, one targeting DIY painters and the other one - professional painters, were distributed in January and February 2015. Online survey was published in both Finnish and English languages on Facebook pages of Tikkurila (Fig. 43) and Natural Interest, Tikkurila’s website and also on the Avainklubi website. A paper survey was distributed among participants at training events for professionals.

390 households and 43 professionals answered to the survey questions. A list of questions for the surveys can be found in Appendix B and C at the end of this research.

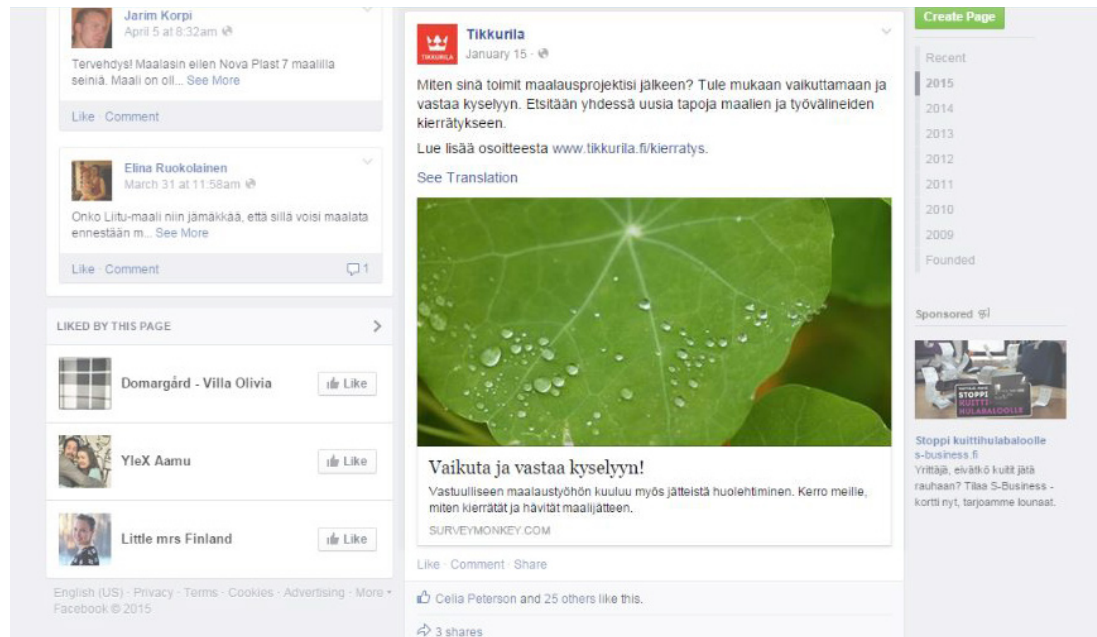


Figure 43. Survey posting in social network (Source: Tikkurila's Facebook page 2015).

Comments shared by the respondents showed some of the wishes and ideas that they wanted to share. Problems, ideas and comments shared by respondents are described and analyzed in the following chapter 9.

S LCA showed that out of five life cycle stages, the use and the end-of-life phases of paint brought some of the most significant negative impacts on the natural environment and human well-being.



Image source: [freeimages.com](https://www.freeimages.com), content license

FINDINGS

After preliminary research, an action plan for a take-back system and guidelines for a pilot project were decided to be delivered at the end of the project. During the research project, however, the following discoveries made this research scope wider and changed the order of priorities:

- Stakeholder engagement process would realistically take more time than four months (due to a wide network of waste management organizations in Finland, a recently updated waste legislation and changing roles of the waste management actors).
- Some of the decisions in relation to plastic and metal packaging are still to be made (due to recent changes in waste legislation).
- A program for paint reuse should be developed before initiating paint recycling, due to smaller investment and less stringent licensing requirements.
- Use of waste paint for manufacturing of non-paint products has not been tested on a wide scale in Finland. To recycle paint in non-paint products requires cooperation partners and testing of materials;
- Both stationary and mobile paint waste collection are already undertaken by local waste management companies. Organizing an alternative system would first require agreements between waste management companies and paint industry stakeholders require agreements between management companies and a paint manufacturer.

Due to the above mentioned findings, it was decided to shift focus from a pilot project to outlining more general guidelines for a take-back system of post-consumer paint.

9.1 SLCA

SLCA showed that out of five life cycle stages, the use and the end-of-life phases

of paint brought some of the most significant negative impacts on the natural environment and human well-being.

Color-coded matrix showed that at the end of a product life, three out of four sustainability principles were marked orange, which meant that they needed special attention. Results from 83 internal surveys, 67 follow up surveys, 4 interviews with the company's internal specialists and 6 interviews with external experts confirmed that the question of leftover paint has not been yet addressed properly in the context of Finland. Leftover paint presented a growing burden for both individual and professional user groups.

Based on the results of the assessment, an action plan was introduced to the company. A list of opportunities for improvement was sub-divided into groups, according to short-, medium- and long-term goals.

In order to change the situation with paint and packaging waste, it was suggested to look for ways to close the 'loop' of paint life cycle.

9.2 Interviews

From the professional point of view, according to the group development manager Jarkko Mattila, professional painters are ready to use those environmental solutions, which do not affect their competitiveness in any negative way (Mattila 2014, pers. com., November 26). The problem with waste paint management is that it is expensive and waste is accumulated to be disposed once (or few times) a year. A fast and convenient solution would be highly desirable for professional users.

During the interviews it was mentioned that retail outlets experienced inconveniences of managing their own waste paint (results of customer returns and tinting in-store mistakes). A sales director from Maalarimestarien expressed an idea that a take-back system for paint waste could become an additional value proposition for customers buying latex paints (Saarni 2014, pers. com., November 25). The service could also benefit stores if they could dispose of their own paint waste at the same time.

The question about using waste paint as a component for manufacturing non-paint materials caused the biggest hesitation. Safety regulations and quality control were named as possible problems. Leif Wirtanen, RDI manager in Tikkurila, listed several possible challenges (Wirtanen 2014, pers. com., November 26):

1. Compromised material appearance due to the possible tinting of waste paint

2. Possible leaching of toxins from waste paint
3. Increased amount of product emissions and resulting from that obstacles in obtaining M1 classification (one of three emission classes for building materials)

Paint re-manufacturing was the second topic that caused a skeptical reaction, especially in the area of safety certification (VOC emission levels and Material Safety Data Sheets) and quality control (mixing different tints and binder type paints can be challenging).

From the interviews with external experts, registration of chemicals with REACH has been mentioned in the interviews as one of the obstacles for developing recycling solutions for liquid paint waste. Another mentioned obstacle was the cost of material separation, which is necessary in order to avoid contamination of recycled packaging material. It is important to note that separate recycling of paint cans faces the problem of small material volumes.

When talking with experts about leftover paint packaging, metal was told to be well recycled in Finland. Plastic packaging, however, was named to be the biggest problem, because it needed to be cleaned before being sent for recycling. Paint is not an easy material for recycling, because it sticks to the packaging material.

9.3 Surveys

The first part of the survey covered demographic information. Although the biggest part of the respondents was from Helsinki region, there was also a significant number of people from other areas of Finland (Fig.44).

More than half of the respondents lived in a detached, semi-detached or a row house. We can assume that they would have a higher demand for the solvent-borne paints to apply to exterior surfaces, while apartment dwellers would be more likely to choose water-borne paints. We have to admit though, that even those respondents, who lived in an

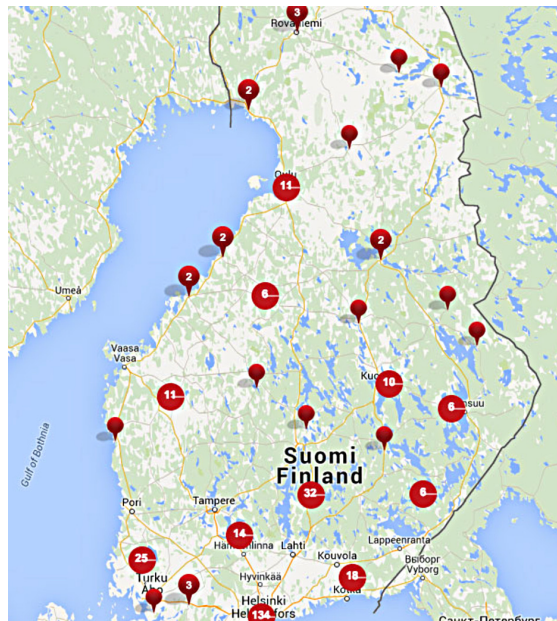
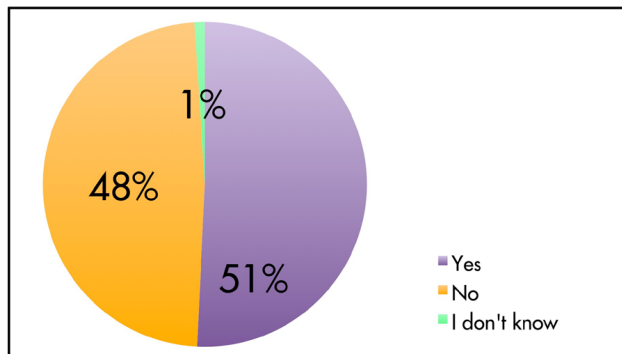


Figure 44. Geography of survey answers (Source: Natural Interest, Paint Waste Survey 2015).

Households:



Professionals:

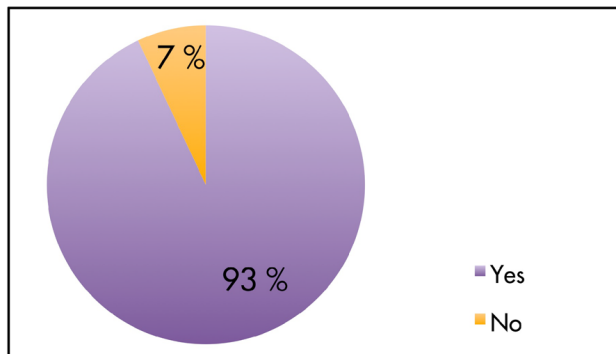


Figure 45. Survey question: Have you purchased paint in the last 12 months? (Source: Natural Interest 2015).

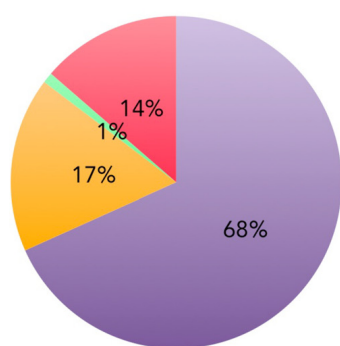
apartment, might have a summer cottage or a vacation home, where they might need to use solvent-borne paints.

From the household survey almost every second respondent had bought paint in the past year. From the professional survey more than 9 out of 10 had purchased paint in the last 12 months (Fig. 45).

74 percent of the household respondents and 70 percent of the professionals recycle their hazardous waste. Only 2 percent of the households and 5 percent of the professionals do not recycle either of the listed materials.

The majority of the respondents from both of the survey groups know where they can take leftover paint for a proper disposal (Fig. 47). However, 31 percent of the households and 19 percent of the professionals are either not sure or don't know how to dispose of leftover paint. The numbers indicate that there is still a large group of people, who do not have correct information. We can assume that they either store the unwanted paint or dispose of it improperly.

Households



Professionals

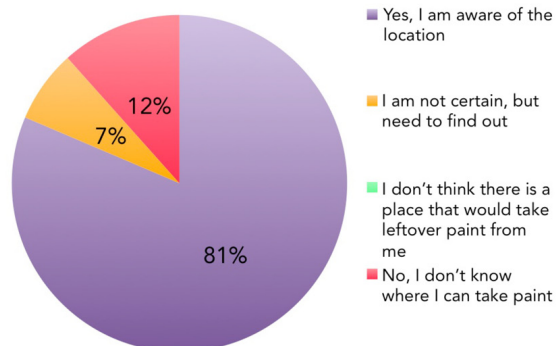


Figure 46. Survey question: Do you know where you can take leftover paint in order to dispose of it properly? (Source: Natural Interest 2015).

Almost 50 percent of the households store leftover paint for future use, which supports the previous assumption. The number of professionals, who store leftover paint and those, who let it dry and then take empty containers to

recycling points is almost equal (Fig. 47).

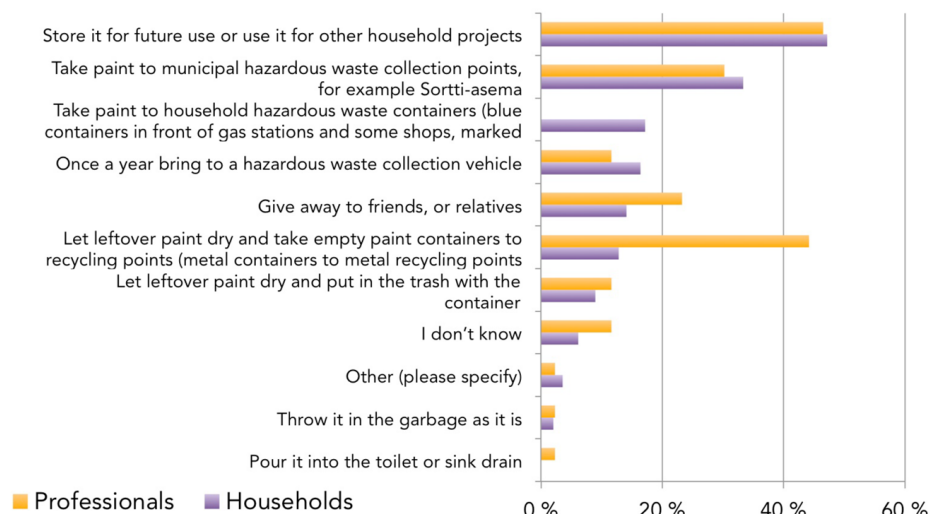


Figure 47. Survey question: How do you usually dispose of unwanted paint? (Source: Natural Interest 2015).

When looking at how people usually take care of unwanted paint, we can see that in all the parts of the country more than half of the people chose only one option (Fig. 48). Smaller number of people uses two or more different ways to get rid of the paint waste.

34 percent of the household respondents and 37 percent of the professionals have containers of unused or leftover paint. From those the majority of households have 1-3 containers, while the majority of professional respondents has over 7 containers. Middle-aged people are more likely to have leftover paint that they would like to get rid of, while young people at the age of 18-24 are least likely to have leftover paint that they are willing to give away.

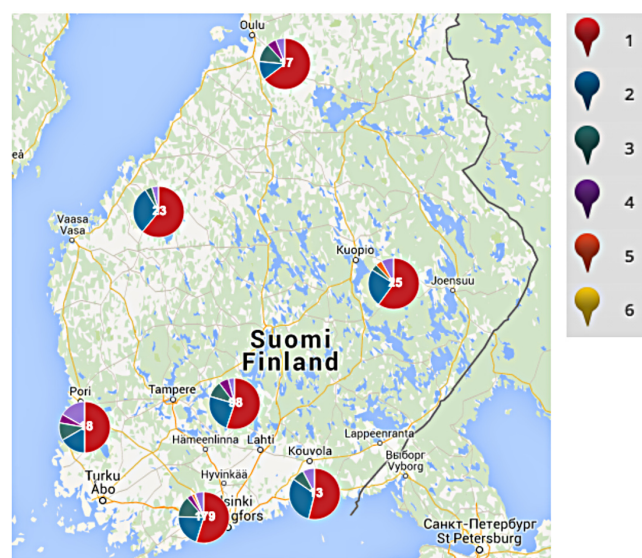
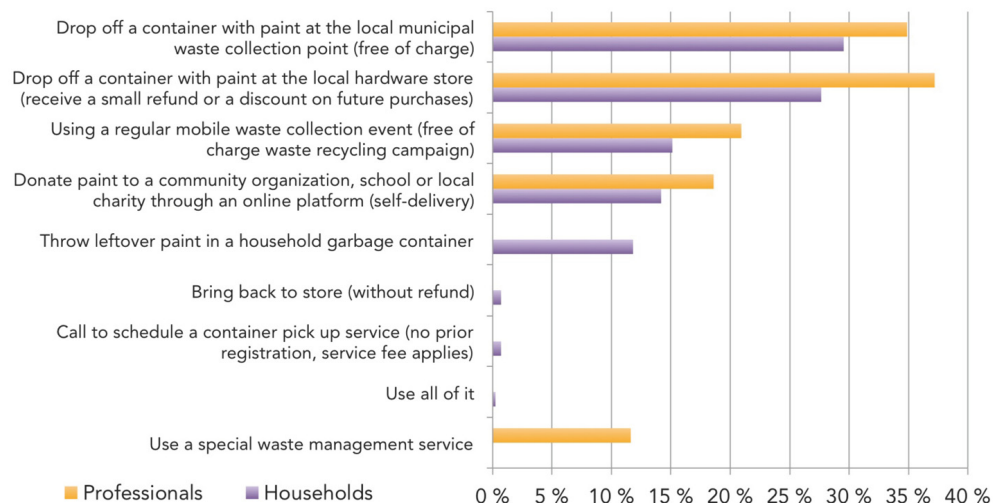


Figure 48. Number of ways that people use to get rid of waste paint (Source: Natural Interest 2015).

50 percent of the respondents to household survey and only 37 percent of the professionals said that they usually purchase water-borne paint. On the opposite, 32 percent of the households and 60 percent of the professionals usually buy solvent-based paint.

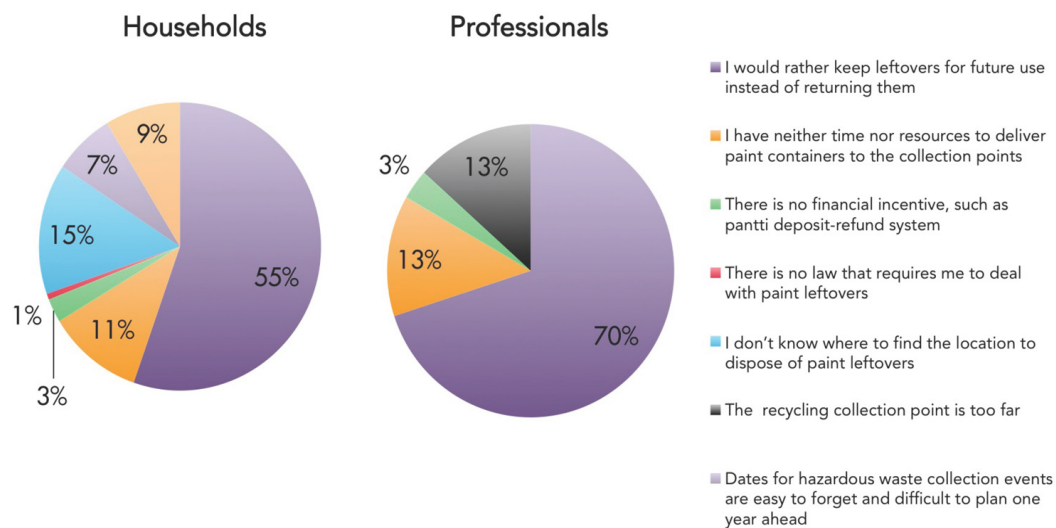
Over 35 percent of professionals and almost 30 percent of the households would prefer either to drop off leftover paint free of charge at the local municipal collection point or to drop it off at a hardware store for a refund or discount on future purchases. Over half of all the respondents (56 percent) chose one option for disposal, 29 percent chose two and 15 percent - from three to four (Fig. 49).

Figure 49.
Survey question:
Which method of paint disposal would you prefer?
(Source: Natural Interest 2015).



The largest number of respondents, 55 percent of households and 70 percent of professionals, answered that the idea that they are going to use leftover paint for future use affects their willingness to return it (Fig. 50).

Figure 50.
Survey question:
What affects your willingness to return leftover paint and empty paint containers?
(Source: Natural Interest 2015).



15 percent of the surveyed households said that they did not know where they could return their unwanted paint and packaging. On the opposite, only 1 percent of the professionals did not know about the return location for waste

paint. From the household respondents 7 percent considered once a year hazardous waste collection to be difficult to plan for and easy to forget about. Only 3 percent of both household and professional respondents saw absence of financial incentive as a reason why they were not too eager to return leftover paint. From the professional users 26 percent of the respondents either had no time and resources to deliver leftover paint for disposal or considered collection points to be located too far away.

9.4 Ideas, Problems and Comments

The survey gave also an opportunity to respondents to give their own ideas, voice out the problems and leave individual comments. In total 71 respondents, which is about 20 percent from the total number, left comments.

Ideas about returning leftover paint to the store

Many respondents felt that it would be convenient if one could return leftover paint either to the point of sale or to any other hardware store:

- *“Returning paint to the original point-of-sale, similarly like a person can give back their used batteries to the shop they bought them from. Also in this way a consumer could save in travel costs.”*
- *“It would be convenient if hardware shops would be willing to receive leftover paint.”*
- *“Paint drop-off points near department stores and malls.”*

Some commented that they would consider a monetary incentive to be a plus:

“If there was a small discount on new paint when returning the leftover paint, it would be great.”

Others shared their ideas about disposal instructions:

- *“The shops selling paint should have clear instructions in how to deal with the empty paint cans, either in the shop or printed on the paint cans.”*

Ideas about public service

An important improvement idea from the respondents was to have the chance to return leftover paint to the municipal recycling containers:

- *“There should be a place in the recycling containers to drop-off leftover paint cans. These should be in every town.”*

Other ideas included:

- *"Municipal rubbish collection car that would also pick up paint"*
- *"More recycling centers where paint can be returned"*
- *Ideas about waste management events and campaigns*
- *General campaign about recycling few times a year*

Ideas about packaging

Being able to buy the right amount of paint was seen as the key to the problem of waste. Respondents said that there should be a packaging solution that would allow to buy a correct amount of paint:

- *"Containers should come in different sizes to allow people to buy more correct amount. It would be great to have a system that allows buying exactly the right amount and have the appropriate packaging for that."*
- *"There should be clear instructions for recycling."*
- *"It is difficult to buy the right amount of paint. Hence there should be some concrete examples of how much can be painted with the can. This would help reducing the paint waste."*
- *"Some information of the hazardousness of the paint would be good. This could help in understanding the importance of not washing the brush for example and let the paint go down the drain."*

Other development ideas

Some other wishes and suggestions included:

- *"The two main issues seem to be the logistics and lack of information. The logistics issue is particularly pressing for those without a car as the recycling places are considered to be inconvenient to reach. In terms of information, there seems to be confusion regarding what to do with the leftover paint and the paint cans. People are unaware whether to put them in the mixed waste or metal recycling. It would be great to take leftover paint back to the shop, just like it would be great to take old household appliances back."*
- *"Recycling should be encouraged more and further. It needs to become a mindset. More education and improvement is needed for recycling in Finland in general."*
- *"It is not economical to simply destroy paint. More creativity is needed*

to find other uses for the particular paint."

- *"The companies, which sell paint should more clearly advice how to recycle the paint. There should be information about where to leave the leftover paint, what to do with dried paint, how to deal with old and dried brushes, how to handle contaminated liquids and so forth. Nowadays the customer has to find out all this information and it can be draining. The result often is to simply leave everything to the mixed waste (sekajäte)."*
- *"There could be help to answer questions regarding handling paint waste on the Internet."*
- *"It would also be important to pay attention to the painting tools such as brushes or rollers."*
- *"Generally more recycling is needed. Some neighborhoods have Facebook pages where people share their leftover paints."*
- *"It should be required by law to recycle paint."*
- *"For people who work and do not have a car it is difficult to appropriately get rid of the leftover paint."*
- *"It would be very useful if a housing company (taloyhtiö) had a container for them [leftover paint]; Returning leftover paint should be made easier than what it is now. Also information regarding this should be easier to find."*
- *"Recycling places like Sortti-asetat are too far away and very difficult to reach for people without a car. There should be more recycling places closer to people."*
- *"For companies who have a lot of leftover paint it would be beneficial to have some sort of "Leftover Paint Bank/Stock" where to leave their paint. There should be some financial incentive for this though."*

9.5 Discussion based on the interview and survey results

Based on the survey results, it is easy to conclude that leftover paint is a relevant topic for both DIY and professional users. However, over 30 percent of households and almost 20 percent of the professional users are either not sure or don't know where they can properly dispose of leftover paint.

Half of the survey respondents chose only one option of how they usually take care of unwanted paint and over half – of how they would prefer to dispose of it; which shows that habit plays a significant role in recycling and is difficult to change. Any new service, which would aim to make leftover paint reuse and recycling more convenient, would need to offer a strong customer value and support motivation it with incentives.

In addition to such reasons, like shortage of time and resources, and a remote location of a drop-off site, people do not always deliver their leftover paint to municipal collection points, because of their habit to store leftovers for 'future use.' More than 50 percent of DIY users and 70 percent of professionals answered that they store their leftover paint for using it in the future. Because open paint containers can dry out, spill and become damaged with mold or rust, recycling of leftover paint, which has been stored for a long time, is not always possible.

Interviews with Tikkurila personnel showed that their professional customers are primarily concerned with a high cost of hazardous waste management and inconvenience of dealing with it (drying the paint by leaving the can open or delivering liquid paint waste to municipal collection points). Ideally a more convenient solution would allow professional painters to save time that it takes to manage the waste. It would also need to be a less expensive alternative to the existing hazardous waste disposal fees.

Deposit-return system

An opportunity was seen with potentially combining retail paint waste and customer returns of leftover paint (which could become a new service). In this case, clients would perceive additional value of a take-back service, and retailer would have a higher amount of foot traffic and occasional sales from customers returning to the store to drop off their leftover paint. The rest of the society would benefit from lower emissions (due to reverse logistics) and a lower risk of hazardous waste to be improperly disposed of.

However, concerns were expressed about handling of hazardous waste, environmental permits and waste management certificates associated with that. Other concerns included the amount of storage required for handling returned waste, as well as the need for extra resources. An idea of including a monetary refund or a discount on future purchases into the paint price found both supporters and opposers. On one side, cash return or a discount would motivate customers to return their leftover paint. On the other side, it could affect market competitiveness of the retail chains and even some paint brands. Based on the interviews with producer responsibility organizations, a deposit-return system for paint containers would be difficult to implement in Finland. It would require different collection bins, enlarged deposit openings and a system for cleaning plastic containers from the leftover paint. The biggest danger with

recycling plastic paint containers is a risk of a recycled material contamination.

An idea of adding plastic lining inside a plastic can could make it possible to move one step forward towards recycling or refilling plastic paint cans. A solution that makes it easier to remove liquid waste from a container would make it more convenient and faster for both DIY users and professionals to dispose of leftover paint.

Minimizing waste

Exact calculation of the required paint amount was seen by many interviewees as the key to lowering the amount of unnecessary waste. Not everyone was familiar with a paint calculator available on Tikkurila's website in Finland.

Another idea, which was mentioned by survey respondents, was paint dispensers, which would allow purchasing just the right amount of paint.

In addition, instructions on the paint packaging could include creative ideas for using leftover paint, such as retouching a fence, painting furniture or adding decorative elements to interior.

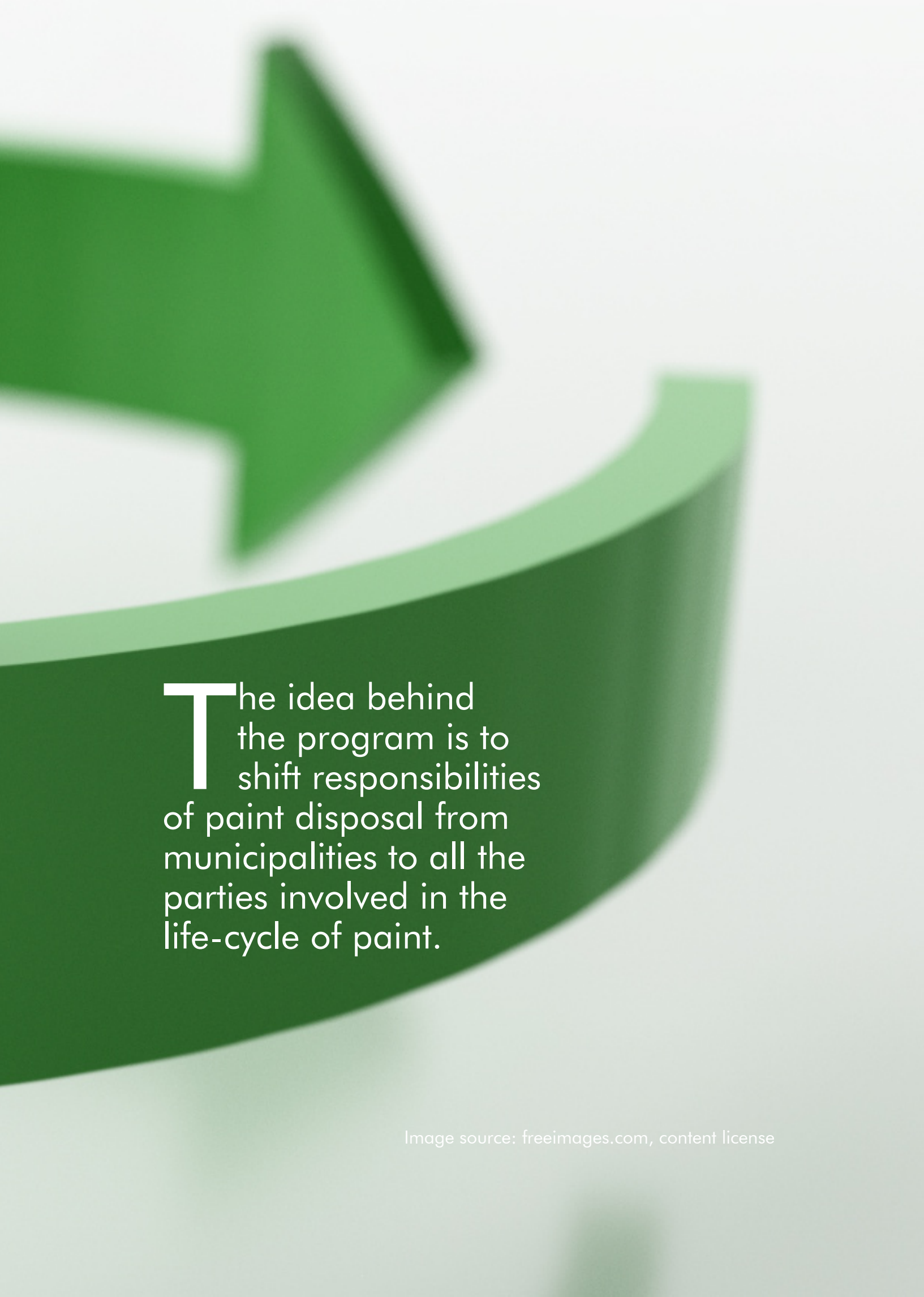
Paint waste as raw material

When speaking about using waste paint as a raw material for other products, such as concrete and plastics, the majority of the respondents expressed their concerns with the final quality of products. Even though there are successful examples of it in the world, they were uncertain if a material, manufactured with a partial content of waste paint would be able to follow REACH requirements.

Paint reuse and recycling

Paint recycling caused most of the confusion. The majority of respondents considered that it was not possible to recycle/remanufacture paint. Main concerns related to using post-consumer paint, which has different chemical content, variety of different tints and, in addition, could have been contaminated with other chemicals. VOC emission levels also caused concerns. Concentration of VOC's in opened paint could not be known for sure and had to be separately tested.

Paint reuse, on the other side, found a lot of support from both the interviewees and survey respondents. Community organizations were mentioned as some of the recipients for donated cans with paint. Social media was suggested as a marketing tool for such a donation scheme.

An abstract graphic featuring a large, dark green arrow pointing towards the upper right. A thick, curved green band sweeps across the lower half of the image, partially obscuring the arrow. The background is a light, neutral color.

The idea behind the program is to shift responsibilities of paint disposal from municipalities to all the parties involved in the life-cycle of paint.

Image source: [freeimages.com](https://www.freeimages.com), content license

SWMP PROGRAM

Drawing upon international benchmarks, interviews, surveys and literature analysis, this research suggests that an optimal way to solve the problem of liquid paint waste in Finland is by introducing a sustainable paint waste management program (SWPM). The program is suggested to be arranged as a volunteer, industry-driven scheme, which would provide a take-back system for liquid latex paint and its packaging. The idea behind the program is to shift responsibilities of paint disposal from municipalities to all the parties involved in the life-cycle of paint, including those who make it (producers) and those who use it (consumers). The program would process only latex leftover paint. Solvent-borne paint, although a primary concern from a hazardous perspective, is suitable well for energy recovery due to its chemical composition.

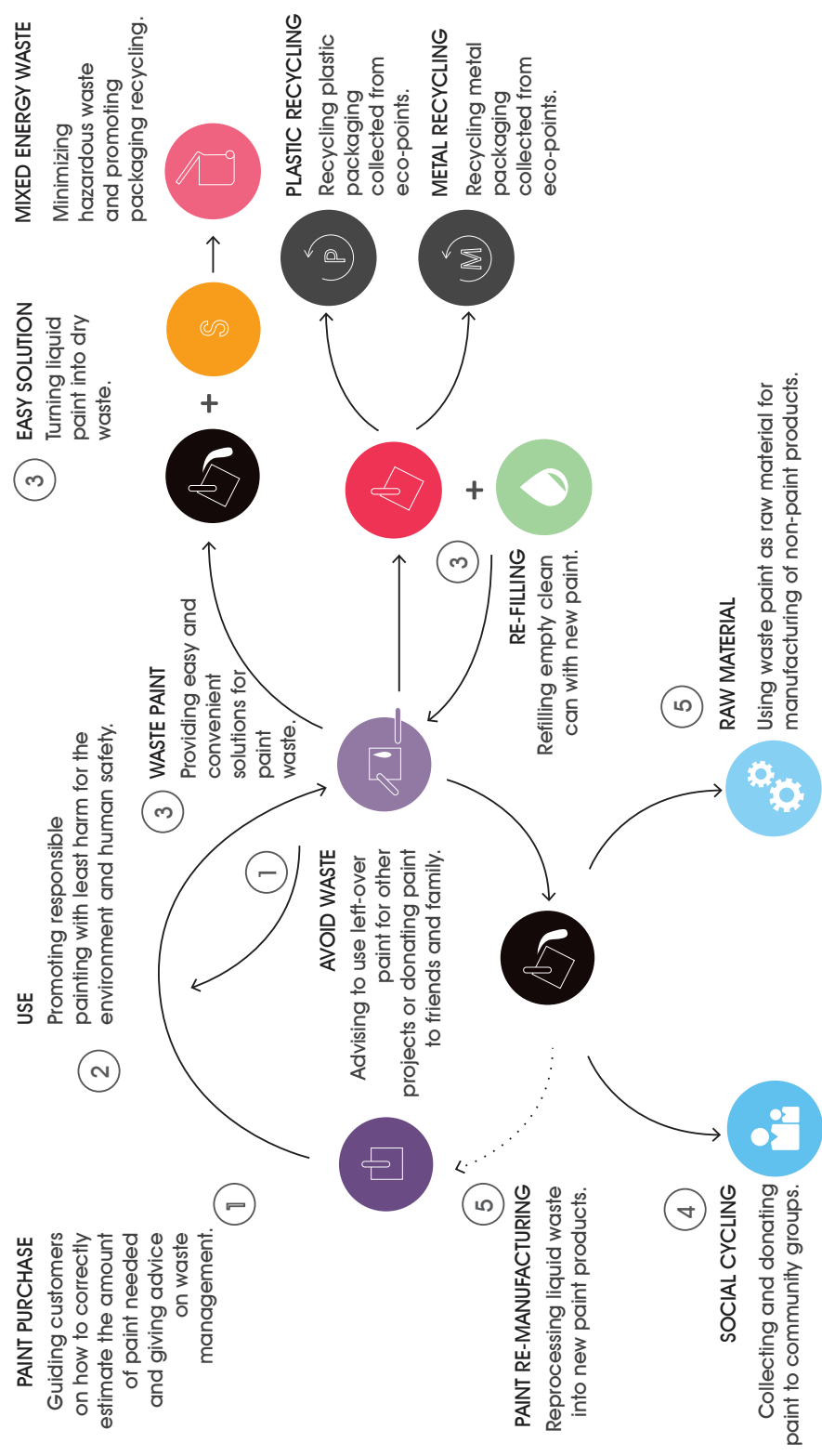
The key components of the SWPM program strategy are (Kissel 2012, p.6):

- Shared responsibility of the industry stakeholders
- Internalized cost
- Set performance goals and measurement metrics
- Consumer engagement

10.1 Program Description

The author of this research is hopeful that recent producer responsibility directive and focus of the European Union on the circular economy model will bring change in the way paint waste is managed in Finland. SWPM program is suggested to be implemented in Finland by using the principle of shared responsibility. This approach means that local authorities, retailers and consumer organizations become closely involved in the program. A paint producer involvement, together

Figure 51.
Proposed future
model for post-
consumer paint
management.



with an independent environmental consulting organization, is would be crucial for taking the first initiative in starting the program.

SWPM program is suggested to use those methods of waste management, which are the highest in the waste hierarchy model. The goal of the program is to either reduce or leave no waste at all. The program itself is presented as a combination of several initiatives (Figure 51, 52):

1. Minimizing waste and changing consumer behavior

*Giving advice on purchasing the right amount of paint
Recommending how to use leftover paint again*

2. Promoting sustainable painting

Giving advice about responsible paint use and disposal

3. Giving easy and sustainable solutions for handling waste

*Solutions to remove liquid paint or turn it into dry waste
Refilling empty plastic containers with new paint or recycling empty packaging*

4. Reusing liquid paint

Donating or swapping paint for social and educational projects

5. Recycling or re-manufacturing of liquid latex paint

*Using paint as a material for manufacturing of non-paint products
Re-blending leftover paint into a recycled content paint
Mixing leftover paint with virgin latex paint to produce new paint*



*Figure 52.
Key for the
program
proposal.*

Partially full paint containers from both DIY and professional customers would be collected at the point of sale. It is recommended that The program would also accept unsold paint, tinting mistakes and damaged paint containers from retailers. Latex paint would be presorted at the point of collection and then transported to the storage facility. Good-quality paint containers, which are at least half full, would be offered to local community groups or low-income individuals. Some paint collected by the program would be sold to manufacturers of non-paint products as a raw material. The best quality paint would be either turned into re-blended or re-manufactured paint; later it would be re-sold to consumers. All solvent-borne paint would be rejected by the program and sent for energy recovery to hazardous waste facilities.

10.2 Timetable

It is suggested that six to twelve months are necessary to develop SWPM program for the capital region and make it fully functional. During the planning and development phase it is important to establish staffing requirements, which might vary based on the expected volumes of waste paint.

Partnership agreements are essential for effective operations. Local authorities, waste management companies, and retail are some of the partners to establish a proactive dialogue with. Contact with waste management regulators and controlling organizations shall be established during the development phase as well.

10.3 Pilot Event

It is expected that recycling and reuse programs will be first tested during a one-day collection event, which will help to estimate waste volumes, evaluate the program success and customer behavior. Siivouspäivä is an example of a recycling event in Helsinki, which would a proactive platform for a pilot event (Fig. 53).

According to Tanja Jänicke, one of the organizers of Siivouspäivä, paint has been previously collected during the event by a local waste management company. Method of its disposal, however, was not discussed with the event organizers. Unfortunately neither the quantity of collected paint nor the number of individuals, who returned paint have not been recorded. Monitoring and evaluating the event is important for identifying opportunities and possible challenges in the future.

10.4 Costs and Incentivization



The cost of the SWMP program will depend on the scale of operations, number of permanent staff, ability to share resources with partners and the number of volunteers.

The starting investment will include equipment, premises cost, safety system and storage containers. Additional costs will come from transportation, staff employment, PR and marketing.

Funding for the program is expected to come from various sources:

1. Deposit-refund fee, which is included in price of a paint can (later it is partially refunded when the leftover paint is delivered back to retail)
2. Fee per liter or annual subscription for the enrollment in paint reuse scheme
3. Manufacturer funding
4. Development and innovation grants from other private sources

Figure 53.
Siivouspäivä
webpage
(Source:
Siivouspäivä
2015).

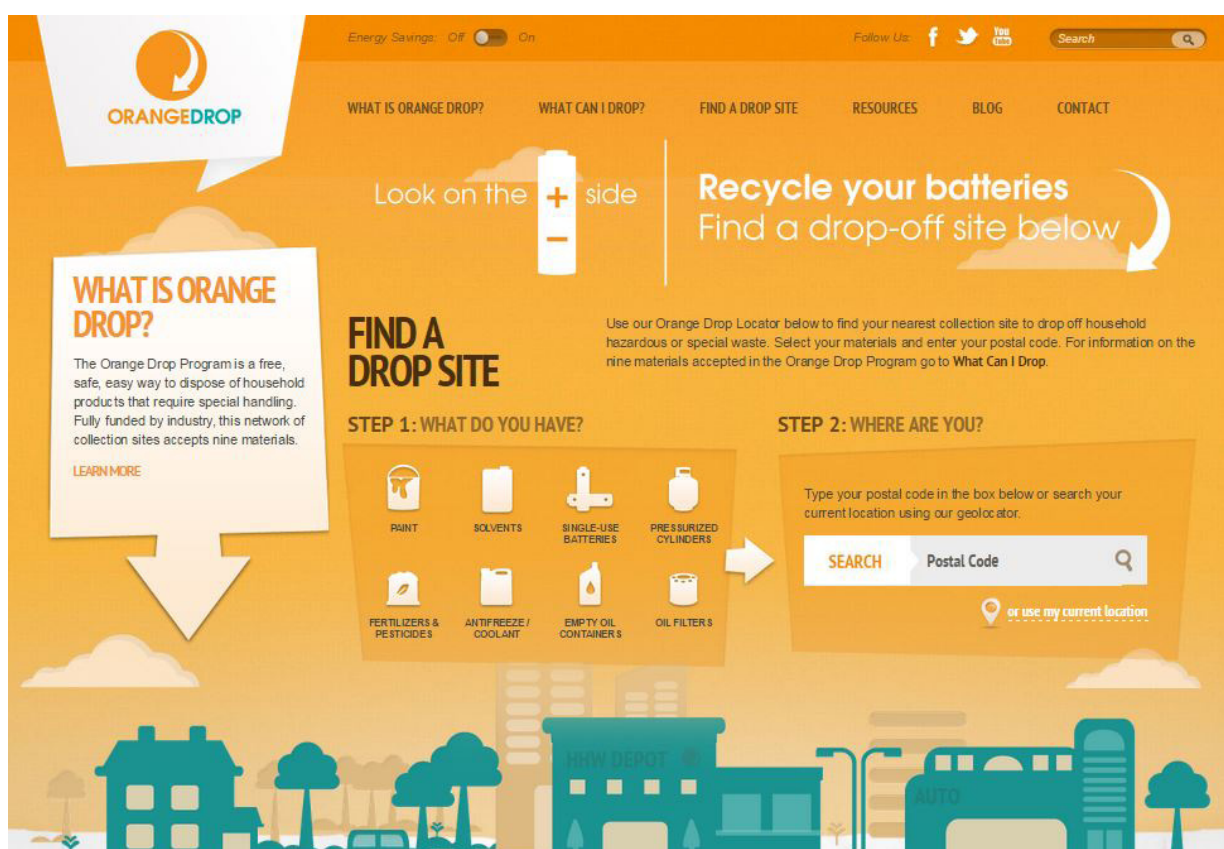
5. Governmental support

During the research a deposit-return fee was a controversial topic. Retail and sales personnel saw the fee as a risk factor. Others saw a similarity with a Finnish pantti system (a take-back system for glass and plastic bottles and metal cans), which has been very successful with its recycling rates. Based on the international examples, it is suggested that a deposit-refund fee is added to those paint products, which will be covered by the SWPM program. The fee is a way to ensure that consumers pay a closer look to the full cost of waste management resulting from a purchased product. The exact fee can be estimated more precisely after a pilot event.

*Figure 54.
Orange
Drop
website
(Source:
Make the
Drop 2015).*

Additional funding could come from the paint allocated for reuse. It could be offered to the public at a lower cost. In comparison, Community RePaint usually offers their paint to local charities and voluntary groups for £1 per liter. Some of their schemes operate with annual subscription schemes (Community RePaint 2012, p. 3).

For DIY users, a social platform could be an effective tool to search for paint dedicated for reuse. For example, in Canada a website called Orange Drop



(2015) helps people to find the nearest drop off site for their paint (Fig. 54). A similar web platform in Finland would offer an option to search for donated paint that is available in the area.

Paint reuse and recycling programs involve comprehensive procedures, such as an in-store leftover paint collection and transportation. These procedures require staff training, health and safety plans. Work training and employment opportunities associated with the SWPM program would be reinforcing governmental efforts towards development of sustainable business ideas and creation of new jobs. The program would also reduce the cost of waste paint management for local authorities and divert paint from the hazardous waste streams.

10.5 User Experience

This research used user experience studies, such as interviews and surveys. In the future, it is recommended to gather in-market data by using ethnographic studies. According to Kramer (2012, p. 92), "ethnography can help discover the actual experience that users have with the product in market." The main difference between distant user studies (such as surveys) and ethnographic research is that in case of the latter, users are observed, while they are using the products. For the purposes of future research, user experience could help to investigate in real life the following questions:

1. Do the services offered by paint manufacturers (paint calculator, phone help-line, and online instructions) help customers to reduce the amount of leftover paint at the end of their painting projects?
2. How convenient do consumers perceive available services for returning their leftover paint?
3. If there are options to refill paint cans with new paint, do consumers find such service to be useful?
4. Do consumers prefer to donate leftover paint for free or to receive a small refund in a store when they return it?

By conducting several user studies and then later combining the results, it is possible to collect quantitative, in addition to qualitative data. A bigger research sample should be included in the future studies.

When searching for new uses of post-consumer paint, measuring progress is very important. Therefore, user experience studies shall inform about consumer attitudes towards new services and possible changes in user behavior.

10.6 Obstacles and Opportunities


Obstacles to achieving the program goals and opportunities for its improvement are assessed in this section. The table below (Fig. 55) lists obstacles and opportunities in relation to each tier of the program.

In conclusion, it is important to remember that stakeholder engagement might be difficult to coordinate if the team, involved in developing the program, is composed of different individuals, who are making decisions based on their internal organizational objectives.

In relation to the local governments, SWPM program might cause a controversial reaction. On one hand, it would be possible for municipalities to reduce financial burden, associated with handling hazardous waste. On the other hand, they might be not ready to give up their responsibilities and the level of control of the waste management. The main reason behind it is a threat to secure employment of the staff (OECD 2004, p. 230).

| PROGRAM CATEGORY | OBSTACLES | OPPORTUNITIES |
|-------------------------------|---|---|
| Avoid waste | Reduction of paint sales contradicts with traditional business goals Paint calculator is not well known among consumers | Work with manufacturers and retailers to establish mutual benefits and strong partnerships Increase educational materials at the point of sale |
| Sustainable painting | It takes time and effort to find instructions, and they are not always followed by consumers | Presenting the steps, which are easy to find (directly from the packaging) and follow |
| Convenient disposal solutions | Some products are still in the research phase | Start product testing and user experience studies prior to taking ready solutions to the market |
| Reuse | Retailers might find it difficult to allocate enough space for left-over paint collection Retailers might be concerned about possible liabilities, accidents and health risks Consumers might have low interest in giving away left-over paint for reuse Consumers might justify over consumption, which would result in higher amounts of left-over paint | Increase number of participating retailers to reduce the volume for each individual store Support retail with training and risk management Educate consumers how to properly handle open paint cans Organize promotional campaigns and provide educational materials for consumers |
| Recycle/ re-manufacture | Matching supply and demand is difficult | Provide a web platform that engages customers and indicates demand for left-over paint |
| | Resistance of retailers to add a waste management fee to paint price | Ensure good communication, so that customers know drop off points Find one paint shop that agrees to test the program and record the changes in foot traffic and sales |
| | Program participants might not have properly established procedure and trained staff | Focus on training |
| | Transportation reduces environmental benefits of recycling | Use reverse logistics |
| | Consumers might have low interest in purchasing recycled and re-manufactured paint | Organize promotions and campaigns Research export opportunities |
| | Recycling paint in non-paint materials is relatively new | Support research initiatives and donate paint for industry testing |

*Figure 55.
SWPM
Program
obstacles and
opportunities.*



One of the key principles of the SWPM program is to stimulate improvements in products and services, and to affect consumer behavior.

Image source: [freeimages.com](https://www.freeimages.com), content license

CONCLUSIONS

This research revealed that sustainability in relation to hazardous materials, specifically leftover paint, does concern consumers, as well as industry experts. This study attempted to look at the waste management system in Finland from a wider perspective. The initial goal of the research was to look for opportunities to make the system more sustainable and improve user experience in relation to leftover paint disposal.

This study suggests that changing the current status of the waste management system requires collaboration between producers, waste management companies and producer responsibility organizations. It is important to understand their individual roles and potential in making an impact. In order to advance in sustainable development, it is essential to use concrete evidence during the dialogue with decision makers and to demonstrate a connection to business strategy.

During the research the author relied on a series of sustainability frameworks, such as SLCA (Sustainability Life Cycle Assessment), Waste Hierarchy, Circular Economy and the Natural Step framework. Sustainability Life Cycle Assessment, similar to a well-known LCA (Life Cycle Analysis), evaluated the environmental burdens associated with leftover paint at each life cycle stage, pointed out the areas which required special attention and saw opportunities for improvements at each particular stage. Waste Hierarchy established priorities in which post-consumer paint shall be disposed of. Circular economy supported the idea of cradle-to cradle, which assumed that leftover paint had to become a material for forming something new, instead of becoming a disposable waste. The Natural Step framework focused primarily on the impact of paint on the biosphere and a shift towards sustainability in complex systems.

Statistics, study of legislation and user research showed that the existing system of paint waste management was unsustainable and had to be altered. Research results helped to identify opportunities for intervention. They also led

to establishing a contact with stakeholders, who were relevant for making a meaningful change in paint waste management practices. One of the discoveries of this thesis work was the understanding that planning for change needs to include both short-term and long-term goals. Short-term goals will help to make current waste management more convenient for the users and prepare them for the long-term change, which will take on more ambitious tasks. The reasons for making short-term and long-term goals are:

- A wide network of stakeholders
- A new waste legislation (which is still in the process of being adapted by the participants)
- An established practice for municipalities to manage household waste (instead of involving manufacturers and/or consumers)

The study demonstrated the need for supporting different methods of managing decorative leftover paint and packaging. The purpose of it is to support the needs of different users and make sustainable management of waste to be as convenient as possible.

Practical research of this thesis opened up a list of opportunities for moving the current situation with paint management up in the waste hierarchy. During this study it was noticed that incineration of the liquid and solid paint waste supported permanent destruction of materials and was one of the reasons why recycling rates remained low in Finland. Paint contains valuable materials, which, even after the use phase, could safely remain in the circular economy and further benefit the society.

As an outcome of this research, a sustainable waste management program for managing leftover paint and packaging (SWPM) was recommended. Based on the interviews and surveys results, it was suggested that the program would be executed in stages with an ultimate goal of closing the loop of a paint life cycle. Starting from the easiest-to-achieve, such as simple and convenient instructions for the users on how to avoid unnecessary waste and to make sure that painting does not harm the environment, the program then offered solutions for convenient disposal of paint. Moving forward, the program supported reuse of paint and packaging and, ultimately, their recycling and re-manufacturing.

One of the key principles of the SWPM program is to stimulate improvements in products and services, and to change consumer behavior by offering additional value to the customers. By linking financial responsibilities to the industry stakeholders and paint consumers, and giving control of the waste management system into their hands, feedback loops would be established.

This research showed that paint and packaging waste management in Finland has not been using all available opportunities for making the processes more

sustainable. Survey results showed that consumers are interested in supporting sustainability efforts and view them as a positive change. The big challenge, however, is to organize the system of waste management in a way, which would make it almost effortless for the users to participate. Clear, simple instructions and incentives can potentially boost reuse and recycling rates. Sustainability does not need to make life more difficult. In fact, it should help people to live in a simple and a more comfortable way.

Below is a list of recommendations for SWPM program developers:

- The program should be executed in two stages: short-term actions and long-term activities.

This recommendation is based on a wide scope of paint disposal services and a range of developed opportunities. Short-term activities are easier to implement and their results can be used for the future engagement activities. Long-term actions need longer planning and will benefit from the data collected after short-term actions.

- A pilot waste management event, as part of short-term actions, should be organized to test requirements of a collection system.
- The program is recommended to be funded by a refundable waste management fee. This recommendation is based on the benchmarking, interview discussions and survey results. It is suggested that a variety of funding would support program's resilience and minimize chances of its failure.
- A user experience study, particularly ethnographic research, of the leftover paint collection system is recommended to improve the program.
- A web platform should be developed to support active customer engagement and to determine current demand for leftover paint.

The following principles should be considered when communicating about a take-back service for leftover paint and packaging:

- It should be easy and convenient

Consumers, especially professional painters, tend to avoid choices that require additional efforts and time.

Example: A take-back point locator with options for shortest distance, fastest route, least driving/walking.

- It has to be positive and personally related

Consumers prefer to commit to actions that "speak" to their positive

values.

Example: Personal stories of those, who have received paint donations.

- It has to provide opportunities for engagement

Consumers tend to be influenced by the physical and online communities.

Example: Forum for participants

Further Research

There are many aspects of the leftover paint management that could not be included in this research work. For example, the future costs of the program are difficult to estimate accurately prior to any testing. Advance financing might be necessary to cover the costs and avoid free riders.

As mentioned earlier, a crucial element of the SWPM program would be the customer feedback. An instrument for data analysis can become part of the further research. Rigorous analysis of the customer feedback can help continuously improve the program and understand the role that it plays in user experience. Consumer discussions on social network and a website platform can be included in the feedback analysis.

For the successful development of the program, administrative, economic and informative instruments need to be involved. Working closer with the government and development of communication strategies can support the next research phase for the program. During future studies different methods of communication can be analyzed based on how strong they influence consumer behavior.

Shifting waste management of post-consumer paint and its packaging to the industry and consumers can become beginning of a growing interest towards product remanufacturing. Moreover, business opportunities of waste repurposing would become more accessible for entrepreneurs once they saw the implemented models. Ideally, the next research phase will include manufacturers of recycled paint located in Finland, or companies, which are interested in including paint re-manufacturing into their portfolio.

This study was limited to liquid latex paint and its packaging. The role of painting tools, however, is seen to be very important in sustainable waste management. In the future, painting tools, such as brushes and rollers, would need to be covered in the studies, as well.

Personal recommendations

The author of this research would advise graduate students, who are thinking about, or are already, writing their master's thesis with a company, understand

that not all research results would be most likely included in thesis writing and approved for publishing. It is wise to have early discussions with a partner company on the level of confidentiality and to make a mutual agreement of what can be included in the publication. Having discussions early enough will make finalizing of a graduate thesis to be a stress-free process and ensure that relationship with a partner company continues in the future.

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Appendix A

(List of interviewees)

| Name | Position | Organization | Date |
|------------------|---|---|--------------------------|
| Kimmo Lylykangas | Architect | Arkkitehtuuritoimisto Kimmo Lylykangas Oy | 13.06.2014 |
| Panu Laitinmäki | Analytic, Equity Research | Danske Bank Markets | 14.06.2014 |
| Kaisa Kekki | Sustainability Director | Skanska | 03.07.2014 |
| Peter Makki | Group Development Management, Business Portfolio and Brand Management | Tikkurila Oyj | 05.08.2014 |
| Per Karneke | Painting consultant | Alcro | 05.08.2014 |
| Teemu Salmela | Managing Director, hazardous waste | Lassila & Tikanoja | 05.08.2014 |
| Jarkko Mattila | Group Development Director, Professionals | Tikkurila Oyj | 07.08.2014 28.11.2014 |
| Niina Silankoski | Hazardous waste specialist | Stena | 13.08.2014 |
| Raimo Laamanen | Logistics Development Manager | Tikkurila Oyj | 13.08.2014 |
| Riitta Eskelinen | Customer insight, BU Finland | Tikkurila Oyj | 18.08.2014 |
| Leif Bergström | Hazardous waste specialist | HSY | 17.11.2014 |
| Timo Hämäläinen | Development Manager | JLY | 19.11.2014 |

| Name | Position | Organization | Date |
|-----------------------|------------------------------|-------------------------|------------|
| Teemu Saarni | Sales Director | Maalarimestarien Oy | 24.11.2014 |
| Anna-Maija Hirvi | Innovation Director | Tikkurila Oy | 27.11.2014 |
| Leif Wirtanen | RDI Manager | Tikkurila Oy | 27.11.2014 |
| Juha-Heikki Tanskanen | Managing Director | PYR | 01.12.2014 |
| Taina Källi | Store manager | K-rauta | 03.12.2014 |
| Juha Pyötsiä | Managing Director | Väriteollisuus | 05.12.2014 |
| Camilla Wiik | Business Development Manager | Ekokem | 11.12.2014 |
| Jarkko Mira | Environmental Expert | City of Helsinki | 16.12.2014 |
| Keith Harrison | Managing Director, Founder | Newlife Paints | 22.12.2014 |
| Marjaneh Zarrehparvar | Executive Director | PaintCare | 02.01.2015 |
| Tapani Sievänen | Managing Director | Mepak-Kierrätys Oy | 12.01.2015 |
| Peter Rasmussen | Managing Director | SUM (Suomen Uusiomuovi) | 13.01.2015 |

Appendix B

(Survey for DIY users)



Responsible painting also includes appropriate disposal of waste. Recycling is becoming a common practice, and is gaining popularity among customers as new and better ways to recycle become available. Our aim is to minimize the environmental impact of our products, promote better practices in paint waste disposal, and increase the recycling of packaging. We are also working to further improve our own waste management.

Towards the end of 2014, Tikkurila launched a waste management project as a joint effort with retail, paint industry organizations, and various players within waste management and recycling. The goal of the project is to provide customers, retailers and Tikkurila alike with a practical system for managing paint waste, as well as to help us address future legislative changes.

We are happy to have you voice your opinions and participate in our project!!

Tikkurila instructs its customers in the correct way to recycle or dispose of painting and packaging waste, as well as in the proper cleaning of tools. Read more from our recycling site in Finnish at www.tikkurila.fi/kierratys

Paint waste questionnaire (households)



NATURAL
interest



*** 1. In what town do you live?**

*** 2. In what kind of housing do you live?**

apartment building

row house

detached or semidetached house

Other (please specify)

*** 3. What is your age?**

Under 18

18–24

25–34

35–44

45–54

55–64

Over 65

*** 4. What is your gender?**

Male

Female

*** 5. What is your total household income (€ per year)?**

20 000–35 000 €

35 000–50 000 €

50 000–70 000 €

70 000–100 000 €

Over 100 000 €

*** 6. What is your highest completed level of education?**

Basic education

Upper secondary, vocational or apprenticeship training

Bachelor's degree

Master's degree

Licentiate or PhD

Other (please specify)

***7. Do you recycle any of the following materials?**

- Metal
- Plastic
- Paper
- Cardboard
- Glass
- Bio
- Hazardous waste
- I don't recycle

***8. Have you purchased paint in the last 12 months?**

- Yes
- No
- I don't know

***9. Do you know where you can take leftover paint in order to dispose of it properly?**

- Yes, I am aware of the location
- I am not certain, but need to find out
- I don't think there is a place that would take leftover paint from me
- No, I don't know where I can take paint

***10. How do you usually dispose of leftover paint?**

Throw it in the garbage as it is

Pour it into the toilet or sink drain

Let leftover paint dry and put in the trash with the container

Let leftover paint dry and take empty paint containers to recycling points (metal containers to metal recycling points and plastic containers to energy waste)

Take paint to municipal hazardous waste collection points, for example Sortti-asema

Take paint to household hazardous waste containers (blue containers in front of gas stations and some shops, marked with a red sign "Kodin vaaralliset jätteet")

Once a year bring to a hazardous waste collection vehicle

Store it for future use or use it for other household projects

Give away to friends or relatives

I don't know

Other (please specify)

*** 11. Do you have any containers of unused or leftover paint you are wishing to get rid of? If yes, approximately how many?**

No, I don't

Yes, 1–3

Yes, 4–6

Yes, over 7

I don't know

*** 12. What type of paint do you usually purchase for home projects?**

Waterborne (latex paint)

Solventborne (oil-based paint)

Both

I don't know

*** 13. Which method of paint disposal would you prefer?**

Throw leftover paint in a household garbage container

Drop off a container with paint at the local municipal waste collection point (free of charge)

Drop off a container with paint at the local hardware store (receive a small refund or a discount on future purchases)

Donate paint to a community organization, school or local charity through an online platform (self-delivery)

Call to schedule a container pick up service (no prior registration, service fee applies)

Using a regular mobile waste collection event (free of charge waste recycling campaign)

Other (please specify)

*** 14. What affects your willingness to return leftover paint and empty paint containers?**

I would rather keep leftovers for future use instead of returning them

I have neither time nor resources to deliver paint containers to the collection points

There is no financial incentive, such as pantti deposit-refund system

There is no law that requires me to deal with paint leftovers

I don't know where to find the location to dispose of paint leftovers

Dates for hazardous waste collection events are easy to forget and difficult to plan one year ahead

Other (please specify)

15. We greatly appreciate your feedback! If you have additional comments or constructive criticism regarding management of the leftover paint, please leave them below.

Appendix C

(Survey for professional users)



Responsible painting also includes appropriate disposal of waste. Recycling is becoming a common practice, and is gaining popularity among customers as new and better ways to recycle become available. Our aim is to minimize the environmental impact of our products, promote better practices in paint waste disposal, and increase the recycling of packaging. We are also working to further improve our own waste management.

Towards the end of 2014, Tikkurila launched a waste management project as a joint effort with retail, paint industry organizations, and various players within waste management and recycling. The goal of the project is to provide customers, retailers and Tikkurila alike with a practical system for managing paint waste, as well as to help us address future legislative changes.

We are happy to have you voice your opinions and participate in our project!!

Tikkurila instructs its customers in the correct way to recycle or dispose of painting and packaging waste, as well as in the proper cleaning of tools. Read more from our recycling site in Finnish at www.tikkurila.fi/kierratys

Paint waste questionnaire (professional users)



*** 1. In what town do you live?**

*** 2. In what town do you work?**

*** 3. What is your age?**

Under 18

18–24

25–34

35–44

45–54

55–64

Over 65

*** 4. What is your gender?**

Male

Female

*** 5. What is your highest completed level of education?**

Basic education

Upper secondary, vocational or apprenticeship training

Bachelor's degree

Master's degree

Licentiate or PhD

Other (please specify)

*** 6. Does your company recycle any of the following materials?**

Metal

Plastic

Paper

Cardboard

Glass
Bio
Hazardous waste
I don't recycle

***7. Has your company purchased paint in the last 12 months?**

Yes
No
I don't know

***8. Do you know where your company can take leftover paint in order to dispose of it properly?**

Yes, I am aware of the location
I am not certain, but need to find out
I don't think there is a place that would take leftover paint from me
No, I don't know where I can take paint

***9. How does your company usually dispose of leftover paint?**

Throws it in the garbage as it is
Pours it into the toilet or sink drain
Lets leftover paint dry and put in the trash with the container
Lets leftover paint dry and take empty paint containers to recycling points (metal containers to metal recycling points and plastic containers to energy waste)
Takes paint to municipal hazardous waste collection points, for example Sortti-asema
Once a year brings to a hazardous waste collection vehicle
Stores it for future use or uses it for other painting projects
Gives away to employees and colleagues
I don't know
Other (please specify)

***10. Do you have any containers of unused or leftover paint you are wishing to get rid of? If yes, approximately how many?**

No, I don't
Yes, 1–3
Yes, 4–6
Yes, over 7
I don't know

***11. What type of paint does your company typically use for painting projects?**

- Waterborne (latex paint)
- Solventborne (oil-based paint)
- Both
- I don't know

*** 12. Which method of paint disposal would your company prefer?**

- Throw leftover paint in a household garbage container
- Drop off a container with paint at the local municipal waste collection point
- Drop off a container with paint at the local hardware store (receive a small refund or a discount on future purchases)
- Donate paint to a community organization, school or local charity through an online platform (self-delivery)
- Call to schedule a container pick up service (no prior registration, service fee applies)
- Using a regular mobile waste collection event (free of charge waste recycling campaign)
- Other (please specify)

*** 13. What affects your company's willingness to return leftover paint and empty paint containers?**

- I would rather keep leftovers for future use instead of returning them
- It brings additional expenses to the business
- Delivering leftover paint to collection points takes too much time and resources
- There is no financial incentive, such as pantti deposit-refund system
- There is no law that requires me to deal with paint leftovers
- I don't know where to find the location to dispose of paint leftovers
- Dates for hazardous waste collection events are easy to forget and difficult to plan one year ahead

Other (please specify)

14. We greatly appreciate your feedback! If you have additional comments or constructive criticism regarding management of leftover paint, please leave them below.

